Class SK274
Book .F58

Title

Imprint

16—30299-1 GPO

TRAJECTORIES

OF

AMERICAN HUNTING RIFLES.

A SERIES OF TESTS, MADE BY THE

"FOREST AND STREAM,"

AT THE

CREEDMOOR RANGE, Sept. 26–Oct. 19, 1885.

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NEW YORK:
FOREST AND STREAM PUBLISHING CO.
1885.

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"FOREST AND STREAM" OFFICE,
39 Park Row, New York.

IN sending out our report of trajectory tests made upon Hunting rifles, it is hardly necessary to make more than the briefest explanation. The trial was intended to show just what the rifles of to-day, loaded with the ammunition as it is turned out by the millions of rounds, could accomplish in the way of flat line of fire.

We had given up column after column in the FOREST AND STREAM to communications on this subject and there had been no end seemingly of speculations and wild empyrical writing on the matter; but what was needed was a set of experiments carried out under carefully noted conditions and by such experts as should command general acceptance of the results. Our pages for years past are rich with accounts of isolated experiments, but there had been no general gathering of all the arms in open competition, and it was this opportunity which the FOREST AND STREAM presented to the manufacturers of small arms in this country. Our invitation to contribute arms was almost universally accepted, and on every side we were given every aid and encouragement in reaching the figures presented, and in proper place in our report acknowledgment is made for the courtesies received from various parties.

We flung the door as widely open as we could. There were no entry fees, no limitations of any kind. We simply asked for stock rifles. We took notes of them in every way. We put in them the ammunition recommended and all were treated with the same care and accurately calculated as to results. We did not go off into side issues. It was not a test of accuracy, of penetration, of velocity, of momentum, of bullet, of anything in fact but the simple question of how high a certain bullet flies in going over a certain distance, and this to be determined by experiment, and not by any calculation from tables of factors each of which might introduce an element of error.

When we have found it necessary to criticise, it has been only in the most kindly spirit. We know that rifles tested in this way are apt to prove obstreperous and cut up queer didos at critical moments. So we have reached the results announced from an average of several shots fired, and all the facts and figures have been given fully and freely for our readers' perusal. We conceived it to be the duty of a progressive journal devoted to sports of the field to make such a trial, and though the expense has been large and much time and trouble expended, we can only hope that readers of the FOREST AND STREAM will find in our table and narrative the answer to many vexing questions and open problems.

NOVEMBER, 1885.

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HUNTING RIFLE TRAJECTORIES.

NEARLY three months ago, in August last, the FOREST AND STREAM announced that it would take upon itself the labor and expense of a trial of the trajectories of hunting rifles. The question was one of much importance to every man who uses the rifle in the field, and the discussions from time to time in our columns showed that it was a live topic. There was a large degree of uncertainty as to what was the actual trajectory line of various makes of open sight rifles. Many claims had been put forward for this or that rifle, some private experiments had been made, many of them of a most interesting character, and their results had been duly set forth in our pages. More general tests had also been made and reports covering them given to the public, but there still remained a gap to be filled by just such a set of thorough trials as those conducted by and under the auspices of the FOREST AND STREAM were intended to be.

The general plan was a very simple one. It was first to call in a competent surveyor and have a range laid out, then to place the actual manipulation of the trials in the hands of an expert who should make a report of the actual figures obtained by him. In this way we hoped to put the result obtained beyond all question of doubt or uncertainty. The details of the trial were many and required much time and labor.

We invited suggestions as to the carrying out of the tests, and the vast correspondence which at once sprung up showed how much interest was felt in the work. Some of these letters, as far as space permitted, were spread before our readers, but many more were not put in type. Some of the hints given were valuable, others were evidently given under a misapprehension as to what a trajectory test really was and what it was that we were striving to discover.

The task which we had undertaken grew with each successive day. "A dozen rifles, perhaps, and a couple of days' time on the range," was the first off hand estimate made. Instead there have been nearly forty rifles, the very pick of over a dozen armories and as fine a showing of the perfection to which American small arm manufacture has grown as were ever gathered together at one time. As the work grew, so did the disposition to meet the demands put upon us. We recognized that there were among our readers users of every make of rifle now on the market. One subscriber in the Western plains has a heavy express rifle, using a charge of powder running up to a hundred grains or more. He is particularly concerned to know just how far the bullet goes above the line of fire in traversing a certain range. Then the army of men who use the smaller caliber weapons; squirrel hunters, etc, who would like to know just what their favorite rifle is capable of doing. The test grew in this way to be a tournament, and from a few hours' work on the range, which it was at first anticipated would complete the outdoor part of the trial, a full fortnight of hard work from daybreak to dusk was taken up. We have no regrets now that the problem grew to such wholesale dimensions. We would rather congratulate the riflemen of America and of the world that they have such a choice of desirable weapons.

Of course, a test of this sort is not alone of rifles; it is rather of ammunition. The first question put, and especially from the rifle makers, was, "What ammunition do you propose to use?" This was very readily answered. As we wished to take the ordinary commercial rifle from the arm-maker's on the one hand, it was only natural that we should

take the factory ammunition to use in such rifle. We know that there is a feeling against factory ammunition, and that the term is used as synonymous with unreliability. This should not be so, and in great measure it is a fiction—a convenient one, perhaps, to account for bad scores, but one which we believe exists rather in the imagination than in fact. We did not intend the trial to cover the lines of fire of certain arms loaded in a special manner; rather the demand was for a stock rifle such as the average purchaser gets in response to an order sent to the factory, and with this to use the cartridge advertised for it, recommended by the seller and maker of the rifle and procurable by that same average purchaser through an order on any one of the cartridge companies. Such a test would interest the multitude of marksmen; any other would be perhaps a more or less valuable contribution to the science of rifle-shooting, but rather theoretical than practical.

To test the matter thoroughly it was but fair that the figures of the trajectory heights should be given in connection with the figures of weight, etc., discovered by a dissection of the cartridge. This has been done, and to guard against drawing a general conclusion from too limited a premise, the average of three cartridges will be shown, just as on the screens the average of five shots was secured.

How to secure the rifles for the test was a question carefully considered. One plan was to have them sent on trial as to a prospective purchaser, and in this way secure a weapon fair to the maker and on the other hand prevent the placing upon trial of a special arm, perhaps carefully selected from a large number or made up for the purposes of the test. This might have been a satisfactory method so far as results were concerned of getting together the collection of arms used, but would have been very complicated. There is no reason to believe that the rifle makers have any fear of fair competition, and the alacrity with which they came forward and proffered arms for the trial showed that they had no apprehensions as to the result of such an impartial trial as the FOREST AND STREAM proposed to carry out. It was

finally concluded to invite the makers to send arms, and on Sept. 17 the following note was sent:

"In making the trajectory tests of hunting rifles, which have been announced in our columns, we wish to include the ——— rifle. The main test will be over the 200yds. range from a fixed rest through accurately placed screens. We should particularly like to have from the rifles in stock at your works the rifle you would most strongly recommend for all-round hunting purposes. All express and other charges to be paid by us, etc."

This invitation to participate was sent to the principal rifle companies making the following arms: Remington, and Remington-Hepburn, Whitney, Marlin and Ballard, Bullard, Colt, Winchester, Maynard, Wesson, Stevens, and Bay State. The responses came in promptly, and showed on the part of the makers a hearty concurrence in the views and endeavors of this journal. The Whitney Arms Company said: "We will be glad to loan you a rifle for the purpose mentioned. We take it that you want a magazine rifle and we propose to send you to-morrow from our regular stock one of our .40-60 Kennedys, which takes the regular center-fire W. cartridge. All things being equal we have no fears but that the Kennedy will rank with the best." The Winchester Repeating Arms Company said: "We have no choice in the matter of guns which we should like to have tested. Please examine our catalogue sent with this, choose such as you would like to try, and we will send them to you at once."

Lamberson, Furman & Co., agents for E. Remington & Sons, answered, "We will refer your favor to the factory and endeavor to meet your views in the matter."

The Colt Patent Fire Arms Manufacturing Co., of Hartford, replied: "Would say that our .44 and .38-caliber sporting rifles use the same cartridge as the Winchester, Kennedy and other rifles of similar caliber, therefore the trajectory of these rifles would be substantially the same. For our .32-caliber rifle we have a special ammunition made by the Union Metallic Cartridge Co., which we believe makes its shooting qualities superior to any in the market using so light a charge. We would be pleased to enter one of these for the purpose indicated in your letter."

The Bullard Repeating Arms Co. said: "We should be pleased to avail ourselves of your offer to include our rifle in your trajectory test which you are about to make. We are willing for our rifles to be thoroughly tested and do not hesitate to send a full line."

The Marlin Fire Arms Co. responding said: "We should like to have you inform us whether you also want us to furnish the ammunition for testing the rifles or whether you intend to procure it yourselves and if so whose make it is to be. In addition to the Marlin we should like to submit a few Ballard rifles, which, as you probably know, are also very extensively used for hunting."

J. Stevens & Co. at first found it impossible to send rifles for the test, but later, after arrangements had been made to secure this rifle elsewhere, a full line of Stevens rifles was sent and tested.

The Bay State Rifle Company wrote: "We use regular factory ammunition for our rifles, and do not think they are what you require for trajectory tests." No further concern was taken with these arms.

Mr. F. Wesson was away from home at the time of the letter writing, and in order that the rifle might not be omitted entirely from the tests, one was procured from the extensive stock of Henry C. Squires, 178 Broadway, through the courtesy of that dealer, and placed in the trial.

The Massachusetts Arms Company put in one of the Maynard rifles, saying in their note accompanying the package: "Our experience is that the flattest trajectory rifles are not the closest shooters, but that a good deal of accuracy is sacrificed for flat trajectory."

From Thos. Bland & Sons, of 106 Strand, London, makers of the well-known Bland rifle, came a note saying: "We are indebted to Major W. H. Merrill for information that the proprietors of FOREST AND STREAM intend instituting a trial of rifles. We wish to enter the list and have given Major Merrill to understand our wishes. Major Merrill will make all arrangements for our entry." In accordance with this a double-barreled express rifle, the same used in the trials of

the London *Field* and which provoked so much discussion in Great Britain, was placed at the disposal of our experts.

In addition a Sharps hunting rifle, carrying the Government 405 grain bullet cartridge, was placed in the test, and for comparison a State Model Remington of .50-caliber and a regulation three-groove Springfield rifle using the 500-grain bullet was placed on the trial rack. This completed the list of breechloaders, somewhat extended beyond our original plan of a test confined to hunting rifles, but not to any great extent. There were a pair of muzzleloaders, one the property of Major Merrill, tested at 100 yards only, while the other was brought and tried by G. T. Romer, of Peekskill, the shooting associate of Major Merrill in many of his trajectory and other rifle tests. This rifle was tried only at 200 yards. Each of the two last named weapons were of the heavy, magnifying-sight order, and with heavy charges maintained a high degree of accuracy. The full list of rifles in the test was as follows:

1.	MARLIN	.45
2.	MARLIN	.40-60
3.	MARLIN	.38-55
4	MARLIN	.32-40
5.	BALLARD	.40-85
6.	BALLARD	.40-70
7.	REMINGTON	.40-65
8.	REMINGTON	.38-50
9.	REMINGTON	.32-40
10.	REMINGTON	.32 R. F.
11.	REMINGTON	.50 N. Y. State Model.
12.	WINCHESTER	.50 Express.
13.	WINCHESTER	.45-75
14.	WINCHESTER	.40-60
15.	WINCHESTER	.22 Long.
16.	BULLARD	.50 Express
17.	BULLARD	.45
18.	BULLARD	.40-70
19.	BULLARD	.38
20.	BULLARD	.32
21.	WHITNEY	.50 Express
22.	WHITNEY	.40-60

23. STEVENS ..... .38 C. F.
24. STEVENS ..... .32 R. F.
25. STEVENS ..... Hunter's Pet, C. F.
26. STEVENS ..... .22
27. MAYNARD 40-70
28. WESSON ..... .44
29. COLT ..... .32
30. SPRINGFIELD ..... .45 Govt.
31. SHARPS ..... .45 Govt.
32. BLAND ..... .45 Express
33. MERRILL ..... Muzzleloader
34. ROMER ..... Muzzleloader

Except in the case of the muzzleloaders and the Maynard, the ammunition was procured entirely apart from the rifle maker. In not a few cases, boxes of cartridges were shipped with the rifles, but in each instance this ammunition was laid aside, and at the tests only such was used as had been purchased over the counters of one or another of the gun shops of this city.

The arrangements for testing the weapons were of the simplest sort, yet such at the same time as to secure absolute certainty in all the results obtained. The question of a rest was the first one to be settled. We know that much has been said *pro* and *con* on the matter of rests for rifle shooting and no end of theoretical talk and some experiments have been put forth to show that a fixed rest is not a proper one for the purpose of testing a rifle. There is much talk of buckling barrels and springing metal, yet in a test for trajectories it would be manifestly impossible to use other than such a rest as would enable us to say with perfect certainty that the barrel muzzle at each shot was at a fixed and known distance above a base line. This a rigid rest enabled us to determine and for this reason a fixed rest was decided upon. The government rest at the Sandy Hook Ordnance Proving Ground was placed at our disposal, and this was taken to the range at Creedmoor. Originally constructed for use in testing the Springfield army rifle, there were certain changes, made necessary before the rest could be used for the long under-lever action rifles such as the Winchester, Whitney,

etc. To enable these breech actions to be worked without removing the piece from the clamps, a slot was cut in the base which was made to lift up from the rear, working from the front end, and at each dropping into place going back exactly to the same position, against stationary lugs. The barrel was held in place by the hinged clamp which passed over the barrel, having a high hollow center, permiting a free line of sight. The butt-plate rested back against the upright at the rear, being protected from abrasion by a leather lining. When placed in, the side plate came up with a hinge motion, while a screw at the top held it in place. Nothing could be simpler, and every bearing point was protected with narrow strips of rubber packing to prevent any cutting or bruising of the wood or iron work of the rifles. Once in the rest and set level across the barrel, and this fact tested with a spirit level, the adjustment of the sight upon the target became a comparatively easy matter. The lateral adjustment was secured by the screws seen at either side near the rear end. This gave a motion of the entire upper part of the rest holding the rifle, the rear end describing a curve about a fixed joint or stout pin directly below the front end. Of course with each screw brought home the rifle frame was held as in a vise, and by turning upon one side as the other side was loosened, the front sight described a line across the target face. Elevation was attended to by a screw with its accompanying jamming nut seen at the rear of the rest. There was a constant bearing upon the end of this screw bolt and with it there was comparatively little difficulty in getting the finest sort of a sight and shifting ever so slightly as the peculiarities of the rifle seemed to require. The entire iron rest weighed nearly 200 pounds and brought the rifle muzzle between three and four feet above the platform. It enabled very ready shifts from one rifle to another and put each rifle at the moment of pulling the trigger on exactly the same equality. To insure steadiness the rest was placed upon a broad heavy plank foundation, the planks shown being three inches in thickness and some five feet long. Screws through the rest

feet made its firm hold to the platform a matter of quick and sure adjustment.

Having fixed our rifle in position for the first shot, attention may be directed to the screens. In the general view of the range laid out for the tests, they will be seen at equal distances down the range. At the two hundred yards trial they were placed at fifty yards, one hundred yards and one hundred and fifty yards respectively from the muzzle of the rifle, while at the one hundred yards test the distances were twenty-five yards, fifty yards and seventy-five yards. The screens were of the lightest form of tracing paper of the grade known as "Alba" in our shops. This is not the ordinary tissue paper, but is, instead, an oiled tracing paper such as is generally used in architects' and engineers' offices in making copies of drawings. We have heard of wrapping paper being used for such tests, and again of ordinary tissue paper. The former would, of course, offer a great obstruction to the flight of the bullet, particularly if the screen was not carefully placed at right angles with the line of flight, while the very light paper disks may not always be stretched on the frames with that drum-head tightness necessary if exactness is desired. The frames used were of pine five-eighth inch thick with a three-inch width at the inner and upper streaks, two inches down the outer edge and one inch across the bottom. When halved at the corners this made a very stiff frame. They were squared carefully by the carpenter when made, and enabled the paper when pasted on to draw firm and tight. The opening was twenty inches in width and twenty-four inches in height. To hold the frames in place uprights were provided; these were of three by four inch joist firmly planted upon a cross base having two arms each four feet long with foot braces to keep the upright plumb. The arrangement gave a very firm support to the screens. These last were held in place against the uprights by iron clamps indicated on the drawing. The thumb screw in the clamp permitted the ready attachment of a screen and its movement at will up or down, while a single turn of the screws fixed it at any desired

height. The target used was the paper one of the Massachusetts decimal pattern. It was really, it will be seen, a matter of the slightest consequence what pattern of target was used, but these being accurately printed and being readily obtained afforded a means of keeping a permanent record of each shot fired in the tests.

On reaching the range the first thing sought was a clear space where the two-hundred-yard range might be located. General Wingate and General Robbins had both been most kind in proffering the facilities of the range, and in order to interfere as little as possible with the regular matches and troop practice, the old Running Deer screen was chosen to shoot against. In many respects this was advantageous, as it gave a wooden back; while the smaller screen at either wing, not very clearly shown in the drawing, enabled the marker to stand safely within a few feet of the target during the delivery of the shots.

The first step was to have an accurate range as to distance, and then to have a base line fixed from which we might in all confidence measure perpendicularly the shot holes as made. The task of doing the surveying necessary to determine these very essential points was intrusted to Charles H. Haswell, whose ability and standing as an engineer and professional man are known throughout the world. When he had finished his labor there were seven stakes standing in line, each was firmly driven into the ground, and into the top of each was a screw having a flat top. The first stake stood against the broad target fence, the next twenty-five yards up the line, the next at fifty yards, the next again at seventy-five yards, the next at one hundred yards, further away was one at one hundred and fifty yards, while the last one was at two hundred yards. They were in exact line, and the broad-headed screw in the top of each were brought exactly to the same level and that within the thousandth of an inch.

It will be seen at once that we had now all the preliminaries for an accurate test, since it was comparatively easy to take the measurements at the target, at the several screens,

and at the rifle muzzle from the basic line provided. The rifle was first placed carefully in rest, and when securely clamped down a few shots were fired until the bullets were found to gather themselves in or near the bullseye. It mattered not to any great extent how the sights were used, or whether the sighting was on the bullseye. All we cared to know was that the rifle was holding well, and that we could rely on getting the next few shots on the target paper. Then a cleaning rod was passed through the barrel and it was ready for the deciding shots. All this time, of course, there had been no screens in the way. These were now put up From the top of the stake in front of the rifle rest, which in this cut is the 100-yards stake, the distance was taken with the Brown & Sharpe standard steel micrometer scale to the center of the rifle barrel. This was fixed by a fine pin put in the center of a small wooden plug accurately fitting the bore. On each screen a fine ink line, put in with a drawing pen from a T-square placed across the screen, had been placed as a line of measurement. This line was brought to the same distance from the stake below it as the rifle barrel was above the stake below it. The line on the screen was tested with a spirit level, and with the screen placed exactly at right angles with the line of bullet flight there was no danger of the glancing of the bullet, which, as every rifleman knows, may take place from the slightest obstacle. Each screen was placed thus while the target, having had such a fine India ink line drawn across its center, was pinned to the plank backing with this line exactly at muzzle distance above the base line stake below.

When everything was in readiness and the signal given that the range was clear the first shot was fired, not sighted at the target direct, but upon the slight black patch which had been placed on the screen nearest the rifle as a precautionary measure. The shot hole through each screen was numbered, and the same shot given the same number on the target. This was done before another shot was fired, and with abundant assistance did not consume a moment's time. When the next shot was fired it too was numbered consec-

utively, so that when through the five shots allotted each rifle there were corresponding numbers on each of the three screens and on the target as well. While the firing was going on observations were made as to the state of the atmospheric conditions. Readings were had from the barometer, from the wet and dry thermometer and from the anemometer. The accuracy of these observations is guaranteed when it is stated that the instruments used were selected from the extensive stock of Gall & Lembke, of 21 West Union Square, this city.

Before taking the rifle from its rest or disturbing the screens and target, the measurements were renewed and verified at each point along the line—at the rifle muzzle—from the screw head to the hair line drawn across each screen—and to the similar line on the target. These having been taken and duly entered, the clamps were loosened and the screens set free, the thumb screws which held the target were drawn and a few turns of the screw at the top of the rest permitted the rifle to be lifted out. It will be noted that the essential parts of each screen were the fine line and the numbered bullet holes, and this permitted the cutting out of the thin paper sheets and their careful preservation in a portfolio for future measurement. Supposing a shot to have hit exactly upon the center-line of the bullseye, then the distances of the shot-hole above the line on the several screens would have been the trajectory height at those distances, respectively, but the great majority of the bullets struck above or below this center-line, and this necessitated additional calculation, simple, yet not to be slurred over.

In the case of the tip-up barrel rifles, such as the Wesson and Stevens, and in the muzzleloaders, there was an additional bother in the necessity of taking the muzzle height at each placing of the rifle in the rest. The screens remained untouched, and with the small black aiming patch on the first screen nearest the rifle, there was no difficulty in getting on the target. Yet in making the office calculations afterward, each shot in each screen is considered with reference to the muzzle height when that particular shot was fired.

The work on the range began on Sept. 26, when by an early morning train a party consisting of Mr. Henry A. Sinclair, Mr. Charles H. Haswell, the rifle editor of the FOREST AND STREAM, and several assistants went down to Creedmoor. On the platform at Queens were the numerous boxes containing the rifles, the several packages of screens, numerous pieces of lumber for supports, and generally all the paraphernalia of the trial. The inconvenient location of the National Rifle Association range was felt at once, and a long cross-country ride was necessary to reach the place where the firing was to be held. It was a warm genial day, and without delay the surveyor and his aides were busy getting the line over which the bullets were soon to be sent flying on their tell-tale errands. The veteran measurer who has been a sort of mathematical regulator and expert on figures and measurements since New York has taken form as a city, entered into his work with spirit and soon had a row of stakes standing in sentry line, from the face of the Running Deer screen 200 yards up the open lawn. This extreme led to a hollow and it became necessary to erect a stand about four feet high on which to mount the fixed shooting rest. This work was soon accomplished with the assistance of the workmen furnished by Supt. W. H. Brower and a few railroad ties as posts, with heavy plank atop made a platform firm and solid for the shooting at this range. At 100 yards it was not necessary to have any such construction and here the heavy plank base rested directly upon the ground, held in position by stakes. The instruments for the observation of the weather were provided for in shady positions under the platform at 200 yards, while at 100 yards a couple of planks set on end in the ground made a nook in which the thermometer with its double column of mercury and the wet and dry bulbs hung out of the direct sun's rays, while the small aneroid barometer hung beside it. These may be noted in cut No. 2, while above, on the small stick, is seen the anemometer catching the record of all the wind flying along at six or eight feet above the ground. The day was spent in getting all the machinery for the test

into position, and when Monday morning came a rack full of rifles waited in the office building across the range; a shelf loaded down with many hundred rounds of ammunition was close by, and a score or more of screens, each neatly covered with a tightly drawn sheet of tracing paper, were ready for the bullet holes.

There was no special order or rotation in the tests. The rifles were taken up at random, fitted to the rest, and when the sight had been caught on the target the screens were put up and the trial shots fired.

Mr. Sinclair had in his charge the manipulation of the rifles in almost every case, and to his care was put the entire figuring and calculation of the test. Long years of drill in just this sort of work—more particularly in connection with heavy ordnance and the thousand and one forms of firearms used and tried at the United States Proving Ground at Sandy Hook—had given him a superior skill in calculations of just the sort needed in the trajectory tests. The FOREST AND STREAM trial assumed in some respect the character of a Government test, though nominally it was in no wise official, and Mr. Sinclair left his official position as a Government measurer behind him when he left Sandy Hook, and brought along to Creedmoor only his technical knowledge of weapons and his ability as a mathematician.

The first rifle placed in the rest on Sept. 28 was the Whitney .40-60, but this was rather to try the line of fire than to make a record, and the Bullard .40-70 became No. 1 in the capacious note-book which Mr. Sinclar had provided to enter his observations. It was then warm and pleasant, with a light six o'clock wind blowing. The Winchester .45-75 followed, and the first day closed with only two rifles recorded at one range. The fixed rest was behaving well, and so far as could be observed was answering its purpose admirably.

On the morning of the 29th of September the .50 Bullard was brought out, but owing to weakness in the spring lifting the carrier block, was laid aside for a time and the Bullard .45 placed on. This was followed by the Remington-Hep-

burn .40-65, and then came the Bullard .38. The snug little Colt was then given an opportunity to show its merit, and then Mr. G. J. Romer, of Peekskill, having reached the range with his small boy and load of rifles, the afternoon was given up to him. The Bland double-barrel rifle was put on first, and with its tip-up manner of opening the breech necessitated its unshifting from the rest after each shot and the most careful cross-leveling and muzzle measurement at each round. The cartridges for this rifle had been brought by Mr. Romer and were used in the weapon. After the sighting shots and the five test shots from each barrel but one loaded cartridge was left; this was taken for weighing up. Mr. Romer then unwrapped his own muzzle-loader, and having duly put it in order for work, gave five shots and then left two of his charges ready for weighing up.

The next day was one of hard work, and the Marlin .40, Ballard .40-85, Bullard .50 express, and Remington-Hepburn .32-40 followed in quick order. Mr. Addis, from the Winchester Works, was an interested spectator and spent several days watching the test. Among other visitors from time to time were Superintendent Grover, from the Whitney Works; John Bodine and Mr. Weber, of the long-range teams; Geo. Joiner, General Robbins, General Rifle Inspector of the N. G. S. N. Y.; Charles Folsom, of the Stevens Company; while of soldiers from the several regiments down for practice there were visitors and spectators beyond count.

Continuing our narrative of the arms tested, there were put on in order the Remington-Hepburn .38, Bullard .32, the Marlin .38, the Frank Wesson .44, the Winchester .40 60, the Ballard .40-70, while the day ended with the Marlin .32. The day following, Oct. 1, the Maynard was the first tried, followed by the Remington State model military rifle, at the suggestion of General Robbins. The Stevens .32 was tried and then the Marlin .45, marked for a Government cartridge, but used instead with a lighter cartridge. The Whitney-Kennedy .40 rifle was followed in turn by the Remington .32 and a U. S. Springfield 3-groove army rifle. This ended the work on Oct. 1 and for the present the 200-yard shooting.

On Oct. 5, when the work was resumed, the rest was at the 100-yard distance. and here the Winchester .50 was tried with both solid and express bullets. The Bullard .50 was put through the same test, and then in order came the Winchester .40, the Winchester .45, the Bullard .45 and the Bullard .40, and the Whitney .40. The Marlin .32 closed that day.

The Remington-Hepburn .40 followed on the following morning and several others were likewise tried, but a light rain at the time so dampened the screens that in drying they drew out of shape and the measurements were not considered accurate enough for our purposes. This wasted the day and threw the tests over to the 10th, when another fine day was had. The Ballard .40-70, the Stevens .32, the Marlin .40-60, the Remington-Hepburn .32 and the Whitney-Kennedy .50 with both solid and express bullets; the Ballard .40-85, the Marlin .45, the Colt, the Marlin .38, the Remington-Hepburn .40, the Sharps .45, the Winchester long .22 and the Remington .32 closed up the programme of a very good day's work.

On the 12th practice was renewed with the Stevens .22, and there followed in order the Maynard, the Bullard .32, Wesson, and then with the afternoon came the Bland, this time with an express bullet; at first with a clean gun after each shot, as marksman Romer insisted every patched bullet should be fired, and then without cleaning, as we thought every hunter's rifle ought to be fired. The following rifle was the Merrill muzzleloader, with its heavy charge and great accuracy. It is to be regretted that the same muzzleloader was not brought down for both ranges, but we were more desirous of having the English Bland tried, and this was given a most exacting test at both ranges, with solid balls in one case and with hollow bullets in the other. The rifles following were the Stevens .38, the Hunter's Pet, the Remington-Hepburn .38, the Springfield .45, and, last at 100 yards, the State Model Remington .50-cal.

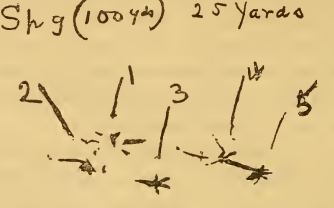
On Oct. 19 the 200-yard range work was resumed. There had been heavy rains on the intermediate days, and fearing

that the stakes might have settled a re-measurement was had, this time taken by the son of Gen. Meserole, of Brooklyn, an accomplished young surveyor. It was found that the stakes had been well and truly driven, and had not varied an appreciable fraction of an inch from the first. The order of shooting now was: Stevens .22, Winchester .22, Whitney-Kennedy .50, with solid and express bullet. The Winchester .50 in same manner. Then the Sharps .45; also the Bullard .50 with express bullet. Then the Hunter's Pet, and then the trials were over so far as the first step of the work in the field was concerned.

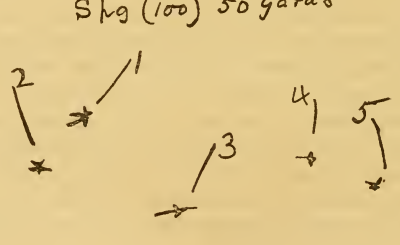
In all there were seventy-four sets of targets made, generally with three screens in each, but only in one instance less, as when at 100 yards one screen was taken down and then another, to see what the retarding effect of the tissue paper was. There were 296 punctured screens, and with five shots in each there were 1480 shot marks in all to find the exact center of and measure up to. In fixing these centers the screen papers were tacked down on a broad, smooth sheet of heavy paper, and with a pair of dividers each bullet hole was centered, a circle struck, and from the fine point made by the divider leg-point, the measure was taken. So on the target, and it may be mentioned to the merit of all the rifles tried that not a single key-hole shot mark was found. Every bullet had traveled dead on and hit with its point. That all those measurements, nearly 2,000 in all, and the subsequent calculations to be made, will explain the delay which followed the completion of the work in the open. Of course it was necessary that all the figuring should be done by one hand, and as far as possible we desired to make the record so exact and so complete that no correction should be necessary at any future date.

The exact manner in which the tests were made, and the subsequent calculations to get at the tables published may be best and most clearly explained by taking the following illustrations of one set of screens with the accompanying target, and showing by them the method of working down the results into their published form. The Springfield rifle

may be taken since this shows bullet marks on the target above and below the center line. First of all it should be understood that the weapon was fitted to the rest and special attention paid to having it level across the piece, that is, having the sights in a vertical line above the center of the

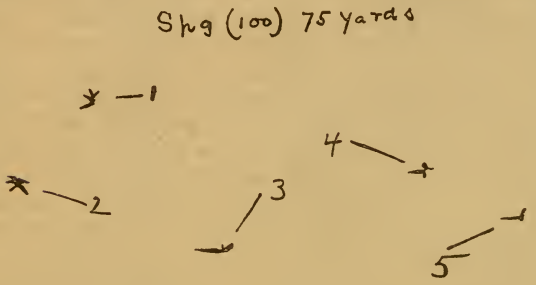


bore. Then it was sighted on the target and a shot fired. The position of the hit was noted, the bullet hole stopped with a patch and a second shot fired to get the arm bearing well toward the bullseye. In the case of this particular rifle the first trial shot struck rather high to the left, the



second was in good elevation, just to the left edge of the bull. All was now ready for measurements, and a plug fitting the bore was put in the muzzle, a pin in the center of this plug of course gave the center of the bore at the muzzle. The distance in a plumb line from this pin to the 100-yard

stake set by the surveyor was then taken by Mr. Sinclair with a Brown & Sharpe improved vernier caliper having a steel rod with points tempered and jaws ground, and capable of measuring with unerring accuracy to the thousandth part of an inch. This height was recorded in the note book.

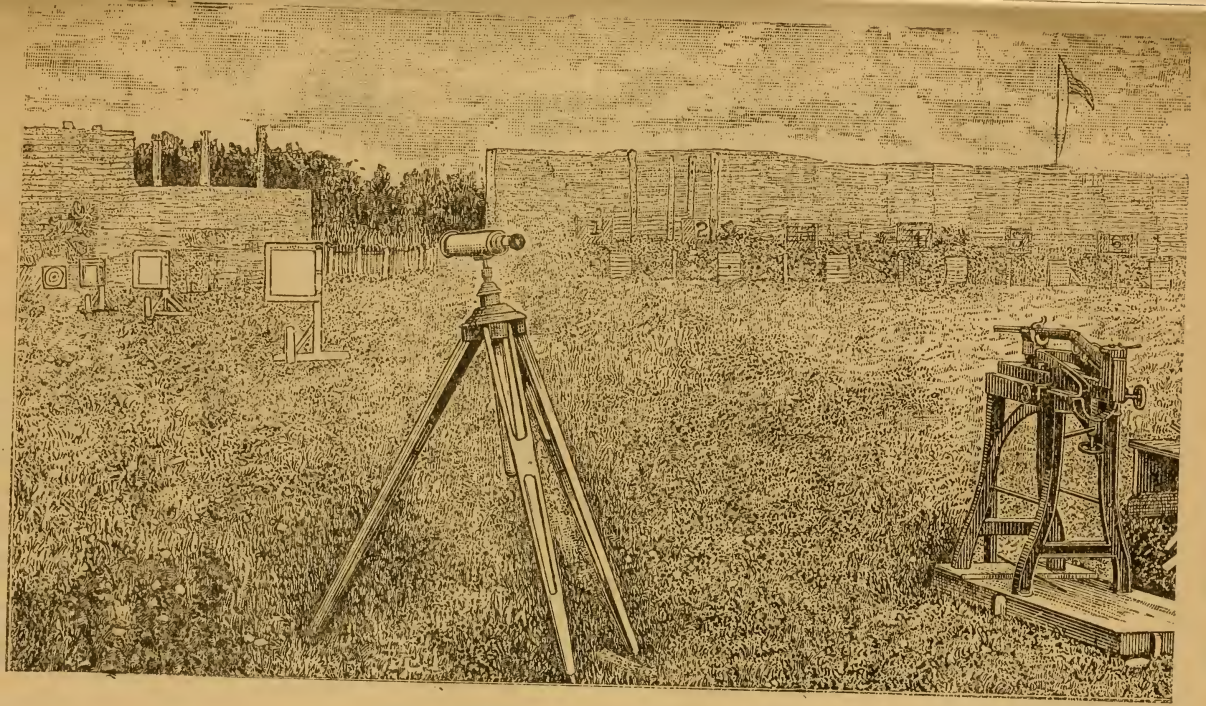


Upon a notched stick the same distance was given as close as a carpenter generally measures, and with a spirit level the carpenter assistant set out to set up the screens on

the 25, 50 and 75 yard posts respectively. Upon each of the screens already stretched and dry was drawn with a right-line pen a fine ink line at right angles to the frame. This line was set about the same level as the gun muzzle, paying special attention to having the line level, by

using the spirit level. While this was going on, the work of a few moments only, the arm was thoroughly scrubbed out with a sharp brush, but without removing it from the rest, so that whatever of barrel buckling or "whipping-down" of the muzzle which might have affected the trial shots was not disturbed in making the final test shots. While the screens were being adjusted, too, the notes were taken of the weather conditions from the fine instruments sent us for the test by Gall & Lembke, of this city. All was now ready for the first shot. When it had been fired the hole or puncture in each screen was marked No. 1, as was the bullet hole in paper target. As the markers stepped aside a second shot was fired, and this in turn was marked No. 2 on each screen and on the target, and so on to the end, each shot passing through the screens and target, until five had been recorded. The screens had not been disturbed, neither had the target paper. A slight lateral motion was given the rifle in order to prevent the holes being too closely bunched on the screens and on the target. This lateral shifting was done in any case where the shooting seemed to be too close, and it may be mentioned to the general credit of all the rifles in the test that there were but one or two instances where it was not necessary.

With the firing of the last shot Mr. Sinclair took up his gauge, and, putting in the plug, verified his muzzle measurement; then on the first screen the distance from the surveyor's stake below to the fine ink line was taken and recorded, at the same time an eye being directed to the question of the correctness of the level set by the assistant. The next screen and the next were similarly treated and recorded, and at the target the distance from the stake to the line across the center of the bullseye was taken and put down at once in the notebook. In other words, we have now got on record the distance of a certain fixed line on each screen and on the target from a known level. This level having been determined in the first place by Charles H. Haswell and verified later in the trials by Surveyor Meserole. The figures as they appeared upon the notebook were:



VIEW SHOWING GUN REST AND SCREENS.

Height of center of bore at muzzle.....16.442 in.
Height of line on 25-yard screen.....16.304 in.
Height of line on 50-yard screen.....16.356 in.
Height of line of 75-yard screen.....16.256 in.
Height of line on target.....17.062 in.

The screens were then cut from the frames, and after the field work was over, they were tacked down on a smooth table and the heights of the centers of the bullet holes taken in a line at right angles with the line on screen. Let us follow shot No. 1—on screen at 25 yards it stood 3.256 inches above line; on screen at 50 yards it measured 4.576 inches above line; on the 75-yard screen it measured 5.162 inches, while on the target it struck 2.692 inches above the center line. Now with these figures it will at once be seen that every element and factor necessary to the determination of the trajectory curve is present. The proper way is to start at zero at the muzzle, and with a corresponding zero at the target get a line connecting them and then find the heights of the bullet holes in the screens above that line. So far as the screens are concerned, by adding together the height of the line and the height of the bullet hole above the line, we get the distance of the hole above the surveyor's level line, and by subtracting the muzzle height we get the distance of the bullet hole above the muzzle.

This calculation would take this form:

	25 Yards.	50 Yards.	75 Yards.
Height of screen line...	16.304 in.	16.356 in.	16.256 in.
Height of bullet hole...	3.256 in.	4.576 in.	5.162 in.
	19.560 in.	20.932 in.	21.418 in.
Muzzle height.....	16.442 in.	16.442 in.	16.442 in.
Bullet hole above muzzle	3.118 in.	4.490 in.	4.976 in.

Now these would be the trajectory heights if the zero point at target, that is the point where the bullet struck, corresponded exactly with the zero point at the muzzle, that is the height of the muzzle, but the bullet struck 2.692 inches above the line on the target, which, as

we have seen, stood at 17.062 inches above the base line. The calculation now is to find the difference in height between the point where the bullet started and the point where it struck, and the figures stand:

Line on target	17.062 in.
Bullet hole above line	2.692 in.
	19.754 in.
Muzzle height	16.442 in.
Bullet above muzzle	3.312 in.

The problem now is to distribute this 3.312 inches of height along the screens. It is manifest that the figures we have found from the screens are deceptively high. We need a new base line, from the muzzle to the hole on target, and not from the muzzle to the center line of target. This is shown on Fig. 1.

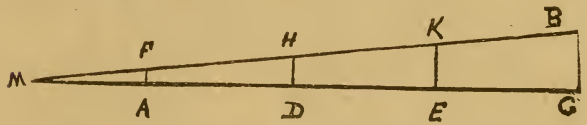


Fig I

M is the muzzle. C same level on target. B the point struck. C B is the 3.312 inches we have determined. A simple geometrical problem tells us that at A, where the 25-yard screen is, the height A F will be one-quarter of the height C B. At D, where the 50-yard screen is located, the height D H is half of the height C B, and at E, where the 75-yard screen is located, E K is three-quarters of C B. In actual numbers the record stands:

C B=3.312 in.

A F=¼ of C B=0.828 in.

D H=½ of C B=1.656 in.

E K=¾ of C B=2.484 in.

Going back to our first table, we are now able to complete it, as follows:

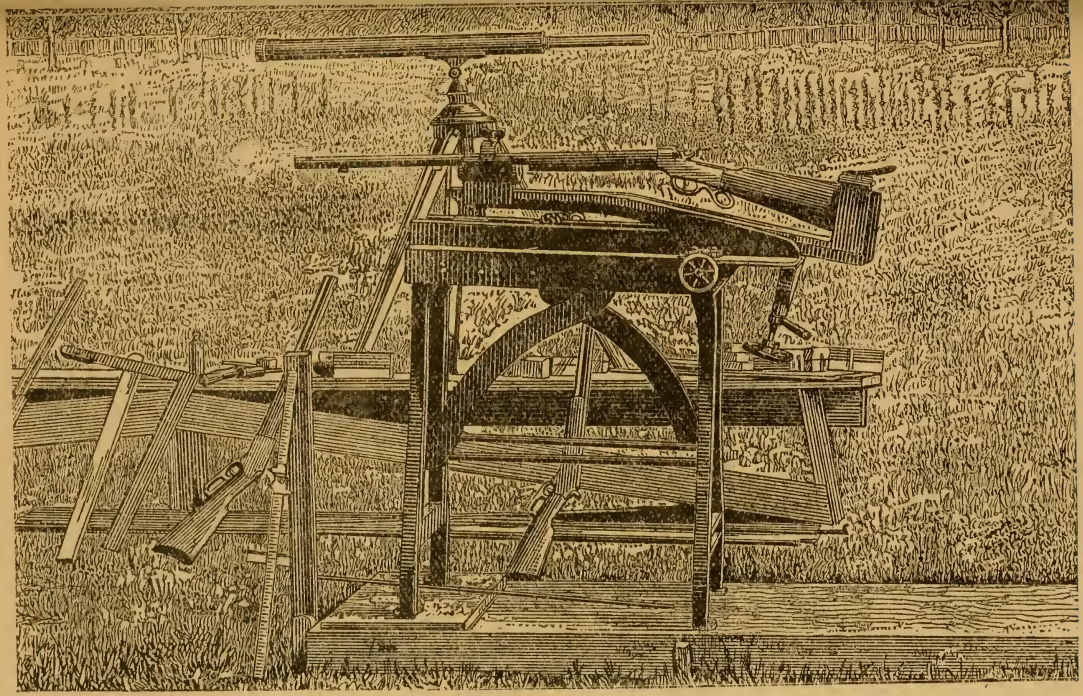
	25 Yards.	50 Yards.	75 Yards.
Height of screen line.....	16.304 in.	16.356 in.	16.256 in.
Height of bullet hole.....	3.256 in.	4.576 in.	5.162 in.
	19.560 in.	20.932 in.	21.418 in.
Muzzle height.....	16.442 in.	16.442 in.	16.442 in.
Bullet hole above muzzle...	3.118 in.	4.490 in.	4 976 in.
Target correction.....	—0.828 in.	1.656 in.	2.484 in.
True trajectory.....	2.290 in.	2.834 in.	2.492 in.

This then is the record of one round through the three screens, and we hope we have made it plain enough to be understood by any one.

Shot No. 2, it will be seen, struck the target above the center line, and without doing more than giving the figures the calculation blank shows, as follows, the screen lines and muzzle height and target line remaining as before: At 25 yards the bullet went 2.586 inches above screen line, at 50 yards it was 3.315 inches, and at 75 yards it stood at 3.115; while on the target it struck .008 above the center line inscribed there, which, it will be recalled, stood 17.062 inches above surveyor's line. The calculations then stand:

	25 Yards.	50 Yards.	75 Yards.
Height of screen line.....	16.304 in.	16.356 in.	16.256 in.
Height of bullet hole.....	2.586 in.	3.315 in.	3.115 in.
	18.890 in.	19.671 in.	19.371 in.
Muzzle height	16.442 in.	16.442 in.	16.442 in.
	2.448 in.	3.229 in.	2.929 in.
Target correction.....	—0.157 in.	0.314 in.	0.471 in.
True trajectory	2.291 in.	2.915 in.	2.458 in.

In shot No 3 we find the screen heights to be at 25 yards, 2.103 inches; at 50 yards, 2.224 inches; at 75 yards it was 1.453 inches, and at the target it struck 2 248 inches *below*



THE GUN REST, SHOWING RIFLE IN POSITION.

the center line. This last will necessitate a reversal of our geometrical diagram, as follows:

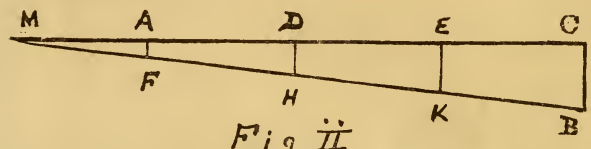


Fig III

The lettering is the same and the same principle applies, but the line of heights first obtained on the screens are plainly too low and need to be increased as the bullet hole is brought from its actual position below the muzzle to a point level with it, and the table stands:

	25 Yards.	50 Yards.	75 Yards.
Height of screen line...	16.304 in.	16.356 in.	16.256 in.
Height of bullet hole...	2.103 in.	2.224 in.	1.453 in.
	18.407 in.	18.580 in.	17.709 in.
Muzzle height.....	16.442 in.	16.442 in.	16.442 in.
	1.965 in.	2.138 in.	1.267 in.
Target correction.....	+0.407 in.	0.814 in.	1.221 in.
	2.372 in.	2.952 in.	2.488 in.

Shot No. 4, when examined on the screens and target, was found to show heights as follows above the ink lines: 25-yard screen, 2.753 inches; 50-yard screen, 3.556 inches; 75-yard screen, 3.465 inches, and target, 0.556 inches. In this case the bullet, striking above the muzzle height, there would be a correction to be made by subtraction, the figuring standing:

	25 Yards.	50 Yards.	75 Yards.
Height of screen line...	16.304 in.	16.356 in.	16.256 in.
Height of bullet hole...	2.753 in.	3.556 in.	3.465 in.
	19.057 in.	19.912 in.	19.721 in.
Muzzle height.....	16.442 in.	16.442 in.	16.442 in.
	2.615 in.	3.470 in.	3.279 in.
Target correction	—0.294 in.	0.588 in.	0.882 in.
True trajectory	2.321 in.	2.882 in.	2.397 in.

The fifth and last round, it will be seen by the target diagrams, strikes below the center line, and in this respect resembles No. 3; and a similar mode of reaching the result is followed. The screen and target measurements were: 25-yard screen, 2.406 inches; 50-yard screen, 2.804 inches; 75-yard screen, 2.366 inches; and on the target 0.960 inch below, and the calculation stands:

	25 Yards.	50 Yards.	75 Yards.
Height of screen line....	16.304 in.	16.356 in.	16.256 in.
Height of bullet hole...	2.406 in.	2.804 in.	2.366 in.
	18.710 in.	19.160 in.	18.622 in.
Muzzle height.....	16.442 in.	16.442 in.	16.442 in.
	2.268 in.	2.718 in.	2.180 in.
Target correction.....	+0.085 in.	0.170 in.	0.255 in.
True trajectory	2.353 in.	2.888 in.	2.435 in.

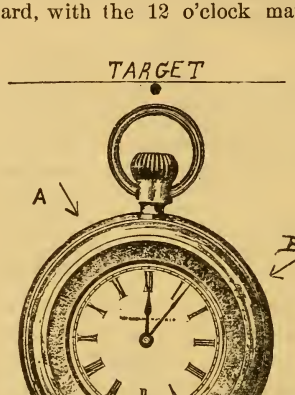
All that now remains is to join these shots into a table to get the average for the five shots; and, to make it more complete, we insert what is omitted, as understood, in the report on each arm, the zero point which we have found for muzzle and target:

Round.	Muzzle.	25 Yards.	50 Yards.	75 Yards.	Target.
1.....	0.....	2.290 in.	2.834 in.	2.492 in.....	0
2.....	0.....	2.291 in.	2.915 in.	2.458 in... ...	0
3.....	0.....	2.372 in.	2.952 in.	2.488 in.....	0
4.....	0.....	2.321 in.	2.882 in.	2.397 in.....	0
5.....	0.....	2.353 in.	2.888 in.	2.435 in.....	0
Average...	0.....	2.325 in.	2.894 in.	2.454 in.....	0

The nomenclature of the wind seems to be, judging from letters of inquiry received, not clearly understood by all of our readers; and when we speak of a "10 o'clock" or a "6 o'clock" wind, the terms convey to the mind of some of our readers no impression of the actual direction in which the wind was blowing. It would be plainly out of the question to use the points of the compass in describing the direction of the wind, unless we had for constant reference a map of

the range. In fact the firing during the tests was almost due north; but we have in all cases used the regular terms employed at Creedmoor, and we think on most of the American ranges, in describing the wind.

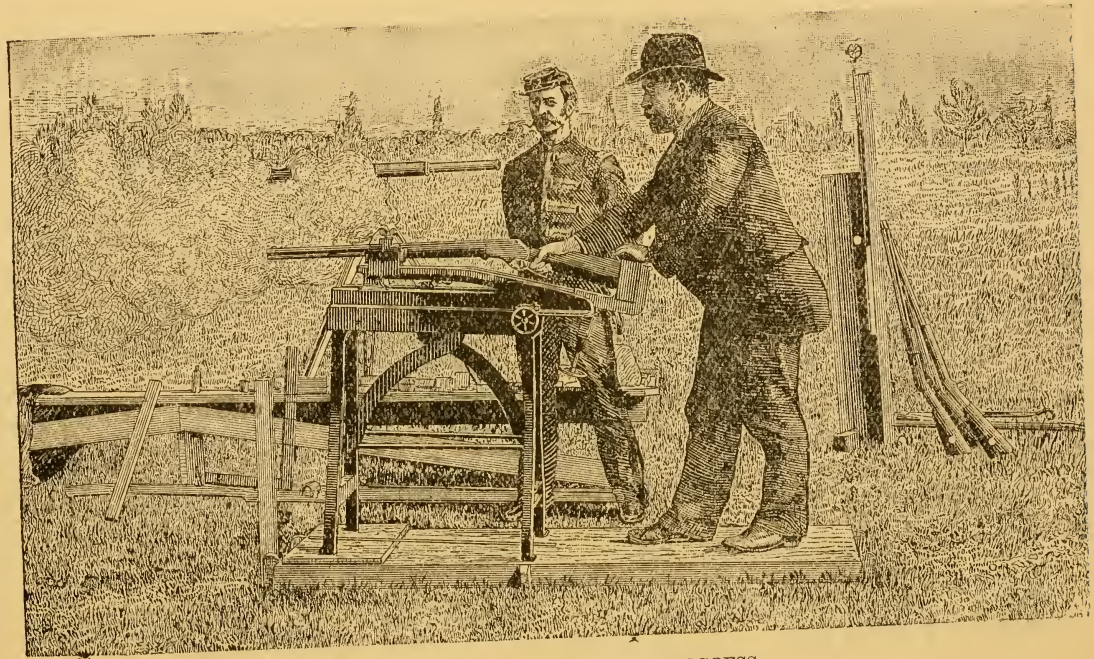
We must suppose that the observer is standing at the firing point facing the target, and that he has in his hand a watch lying face upward, with the 12 o'clock mark toward the target.



Then a wind blowing in the direction of the Arrow A would be called an 11 o'clock wind, as coming from the quarter marked by the figure 11 on the dial. Arrow B will represent a 2 o'clock wind, and arrow C a 4 o'clock wind, and so on for each of the twelve divisions of the dial. A wind coming direct from the target toward the shooter would be 12 o'clock wind, and if it had a habit of shifting first to one side of the meridian and then to the other, it would be a "fish tail" wind. A similar fish tail wind might come from the rear, and would then be a 6 o'clock fish tail wind. With the direction and the force of the wind given,

all is noted that it is necessary to know of the wind part of the atmospheric conditions.

It will be seen that this same device of a dial may be made use of in noting the point hit by a bullet on the target. In this case we must suppose the watch to be hanging on the target face. So a 12 o'clock bullseye would be one near the top, and a 6 o'clock bull would be one near the lower part of the bullseye. So also of inners, and centers, and outers, they could all be accurately and tersely described by this dial nomenclature.



THE TRAJECTORY TESTS IN PROGRESS.

THE TRAJECTORIES.

WE commence our report on the trajectories of rifles by presenting the figures of the .50-caliber weapons. In some respects these are the most interesting of all, in that they include the express bullets and permit direct comparison to be made between the performance of the same rifle with the same powder charge, but using two different bullets. Three different makes of hunting rifles are included in this instalment of our report, together with the figures on our old friend, the Remington State, which it would seem deserves a much better reputation than it generally enjoys. In many cases we think the rifle is fully up to the riflemen, and this applies to many other weapons besides this particular military one. We have given, as far as may be, all the data we have about each rifle. These figures are our own, as far as possible, but the facts about weight of barrel, of rifling and of composition of the bullet we take from the reports or letters of the rifle makers. The examination of the cartridges as to weight of powder and ball was intrusted to a man accustomed to just this sort of delicate manipulation of the balances, and each charge as weighed was put in a small vial for exhibition in our office and for future reference in case of dispute. As far as possible we will illustrate the cartridge used, as this will enable readers to see at once the sort of ammunition employed. Our cut is drawn from an instantaneous photograph, capitally taken at the moment of a discharge. It calls for no special explanation.

Winchester .50, Solid Ball.

This arm was tried at 200 yards on Oct. 19, and was placed on the rest at 11:30 in the forenoon; the wind was then blowing at the rate of 18 miles per hour from the 7 o'clock quarter. The other weather conditions were: Barometer 30.205; dry thermometer 70.5, wet bulb thermometer 65, dew point 61.5 and humidity 73 per cent. The barrel was octagonal, 26 inches in length and bore the factory number of 48006. Weight of rifle 10 pounds 1 ounce, weight of barrel 3 pounds 2 ounces. Rifling 6 groove. Uniform twist, one turn in 60 inches, groove depth .003 and width .160. It was fired with Winchester made ammunition marked .50-95, having a three-grooved solid bullet. Three of the cartridges were opened

and both powder and ball weighed. The latter is composed of 1 part tin to 16 of lead. In the first cartridge opened the powder was found in fair condition and pressed hard, the charge weighing 90.8 and the ball 311.5. In the next the powder was in fine condition, and the weights of powder and ball respectively 91.3 and 313.3. The last one opened turned out the charge in fine condition, the powder weighing 90.7 and the bullet 312.0.

The rifle in the rest behaved very well, and the target was soon found and five scoring rounds secured as follows:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	7.727 in.	11.305 in.	8.625 in.
2.....	7.931 in.	11.270 in.	8.408 in.
3.....	8.459 in.	11.752 in.	8.844 in.
5.....	7.783 in.	11.079 in.	8.415 in.
6.....	7.932 in.	10.903 in.	8.273 in.
Average.....	**7.966** in.	**11.262** in.	**8.513** in.

The 100-yard test of the Winchester .50 express rifle with solid bullet was made on Oct. 5. It was about 11 o'clock in the forenoon, immediately following the trial at

the same range with the express bullet, though the weapon had, of course, been cleaned as it stood in the rest. The wind was then blowing from the 7 o'clock quarter at an eighteen mile an hour rate. The barometer stood at 30.200 inches, the thermometer at 57°, and the wet bulb thermometer at 50°, leaving a dew point of 42 and a humidity of 57 per cent. The ammunition was from the same boxes used in the 200-yard test, and of the condition of which report is made above. A curious result is seen in the calculated figures, especially in the fifth and sixth shots, where the height at 75 yards is seen to be far above that at the middle screen at 50 yards. This novel result would seem to sustain the gyratory motion which it is claimed bullets sometimes take on, especially when traveling at a high rate of speed. It simply means that owing perhaps to some imperfection in the bullet, or it may be to other causes, the ball travels in a sort of corkscrew course, traveling spirally about an imaginary line, while, of course, obeying the forward impulse given it by the powder charge. In other cases during the tests this phenomenon has been even more marked, and every experimenter who has had occasion to narrowly watch and mathematically determine the antics of a bullet in flight will bear testimony to his observation of these facts.

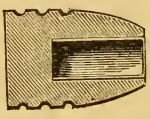
At the 200-yard range it will be noted that this tendency to abnormally high trajectory points at the extreme screen came in the two leading shots, and that in the other shots the line seems to have been the ordinary line with the bullet maintaining its revolution on an axis parallel to and co-existent with the line of flight. The rifle was clean in both cases, and there was not at any time any leading or other physical interruption to correct firing; neither was the arm shooting wildly, and the bullets were in all cases traveling head on. We leave the point open for discussion by others at the conclusion of our report, only making note of the fact that the screens were examined with special care and the calculation thrice repeated, the first and natural conclusion being that some error in figuring had been committed. Under the circumstances, while giving all the results, we

calculate the line of average trajectory to the three upper rounds, where it is evident the bullet was traveling in a normal line. The 5-round average is also given. The figures are:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.554 in.	1.975 in.	1.661 in.
2.....	1.896 in.	2.559 in.	2.124 in.
4.....	1.735 in.	2.141 in.	1.771 in.
5.....	1.660 in.	1.959 in.	2.733 in.
6.....	1.856 in.	2.381 in.	2.763 in.
Aver. (3 rounds)	1.728 in.	2.225 in.	1.852 in.
Aver. (5 rounds)	**1.740** in.	**2.203** in.	**2.210** in.

Winchester .50, Express Ball.

The test with the express bullet was made at once upon the completion of the solid ball record and without any material change of sight; of course all the data about the rifle hold as before and the weather conditions had not changed to any appreciable extent. The Winchester ammunition was used, the three-grooved bullet having the same



composition as before, one of tin to sixteen of lead by weight. The three cartridges opened showed the powder in fine condition in each case. The charges weighed 89.8, 89.3, and 89.3 in order, while the bullets corresponding were 305.3, 298.8 and 300 8. The gun barrel was given a cleaning before the new trial was made, the initial conditions were in every respect uniform. The figures stood:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	7.994 in.	11.362 in.	8.648 in.
2.....	8.139 in.	11.425 in.	8.507 in.
3.....	8 214 in.	11.800 in.	8.835 in.
4.....	7.883 in.	10.829 in.	8.120 in.
5.....	7.780 in.	11.116 in.	8.349 in.
Average.....	**8.002** in.	**11.306** in.	**8.492** in.

The trial of the Winchester .50 express rifle with an express bullet at the 100-yard range immediately preceded the test of the solid bullet cartridge in the same arm and at the same distance. It was about a quarter past ten on the morning of Oct. 5, with the wind blowing at an eighteen-mile-an-hour pace from the seven o'clock quarter. The barometer stood at 30 160, the thermometer at 56, with the wet-bulb ditto at 50, making a dew point of 43 and a humidity record of 62 per cent. Ammunition was taken from the same lot as before. The weapon behaved very well, gave no trouble in handling, and the shots as recorded on the screens do not show more than the average variation and nothing of the gyratory motion so plainly recorded in the solid ball test afterward. The average accordingly is on the full five shots, as follows:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.142 in.	2.401 in.	2.188 in.
2.....	2.124 in.	2.505 in.	2.235 in.
3.....	2.018 in.	2.299 in.	2.030 in.
4.....	2.124 in.	2.416 in.	2.216 in.
5.....	2.072 in.	2.318 in.	2.112 in.
Average.....	**2.096** in.	**2.388** in.	**2.156** in.

Bullard .50, Solid Ball.

This weapon is noteworthy as carrying nominally the heaviest charge of any of the breechloaders in the trial. It was marked 346 in the shop numbers and had a 28-inch round barrel. The total weight of the weapon unloaded was 10 pounds ½ ounce, while the weight of barrel alone was 3

pounds 8 ounces. There were five grooves, having a uniform twist of one turn in 72 inches. It was loaded with Union Metallic Company ammunition from a box marked ".50-

115; for Bullard Repeating Rifle." The bullet had three grooves, and when three rounds were opened the powder was found in fair condition but pressed hard. The powder weights ran 112.5, 112.2 and 113.1, while the bullet weight figures were 350.5, 350.5 and 350 4. The weapon in the rest was rather obstinate, and at times it was necessary to push the carrier block down with a pencil, owing seemingly to the breakage or weakness of the carrier block spring. It was tested at ten o'clock on the morning of Sept. 30, under a three-miles-an-hour breeze blowing from the nine o'clock quarter. The other weather conditions were: Barometer, 30.100; dry thermometer 77.5; wet-bulb thermometer, 67.5; dew point, 61, and humidity, 57 per cent. The trajectory figures show:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	7.385 in.	10.386 in.	7.974 in.
2.....	7.459 in.	10.588 in.	8.350 in.
3.....	7.173 in.	10.179 in.	7.914 in.
4.....	7.044 in.	10.215 in.	7.795 in.
5.....	7.243 in.	10.078 in.	7.807 in.
Average.....	**7.261** in.	**10.289** in.	**7.968** in.

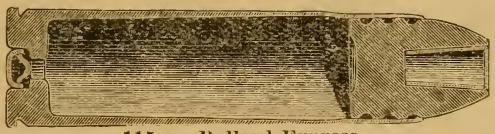
The 100-yard test with the solid bullet was made on the morning of Oct. 5. It was 11:20 when the weapon was fitted to the rest, with favorable weather conditions. The barometric reading was 30.275, the dry thermometer 57, the wet bulb thermometer 51, with a dew point of 45 and a humidity of 64 per cent. The wind, at an 18 mile rate, was blowing from the 8 o'clock quarter. The ammunition was as that used in the 200-yard test, and the figures of trajectory given are worthy of special study. In this as in almost every other case is seen the wisdom of an average result by taking five distinct records, as carried through the entire FOREST AND STREAM trial wherever practicable. A dropping shot, or one of those records which go to show that bullets have a way of their own of wabbling through the air, might upset the conclusions entirely if a trajectory test was made to depend on the figures of a single shot. We give the record as it comes from the calculation blanks, only remarking that every screen and target remains

on file in our office, and that the oft-repeated calculations made to get at this result may be again repeated if at any time it is thought necessary. The record stands:

Round.	25 Yards.	50 Yards.	75 Yards.
2.....	1.555 in.	1.804 in.	1.770 in.
3.....	1.548 in.	1.636 in.	1.361 in.
4.....	1.667 in.	1.894 in.	1.710 in.
5.....	1.476 in.	1.764 in.	1.636 in.
6.....	1.746 in.	1.989 in.	1.810 in.
Average....	**1.598** in.	**1.817** in.	**1.657** in.

Bullard .50 Express, Express Bullet.

The 200-yard trial of this Bullard .50 express was not made until the afternoon of October 19, at quarter past two, when it was put on the rest, with a 27 miles an hour wind blowing from the 4 o'clock quarter. The weather environments of the trial were: Barometer, 30.195 inches; dry thermometer 66.5°; wet bulb therometer 60.5; dew point, 55.5, and humidity 68 per cent. It was loaded with U.M.C. ammunition, and the three-groove bullet was on powde pressed hard and in fair condition otherwise. The box was marked ".50 cal., 115 grains powder 'Express'; for Bullard Repeating Rifle." The weights of the three pow-



115 gr. Bullard Express.

der charges stood, 112.1, 111.2 and 110 15, while the three bullets weighed up to 303.6, 303.7, 306.8 grains respectively. The trajectory heights stood at·

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	6.791 in.	9.888 in.	7.924 in.
2.....	7.828 in.	11.279 in.	9.012 in.
3.....	7.163 in.	10.061 in.	7.982 in.
4.....	7.410 in.	11.188 in.	8.077 in.
5.....	6.841 in.	10.048 in.	7.950 in.
Average.. ..	**7.206** in.	**10.493** in.	**8.189** in.

The trial of the Bullard .50 express over the 100-yard range with the express bullet followed close upon the trial of the heavier solid bullet. The rifle was still warm, and in order that it might start under similar conditions as to the interior of the barrel, a sharp rubbing was given with the brush of the cleaning rod. It was 11:40 o'clock, and the wind was holding from the 7 o'clock quarter, but at a 15-mile-an-hour rate, the barometer mercury was at 30.240 inches. The thermometer was at 59, tho wet bulb thermometer standing at 52, making a dew point of 45 and a humidity of 60 per cent. The loading of the weapon was from the same box as the 200-yard express bullet record.

The figures are again subject to comment, especially the second round, where the 75-yard screen shows a bullet mark fully one-tenth of an inch higher than at the screen 25 yards nearer the target. Again, the bullet would seem to have been corkscrewing its way down the range, and caught the third screen on the upper section of the curve in which it was traveling. The figures as deduced show:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.586 in.	1.789 in.	1.629 in.
2.....	1.585 in.	2.191 in.	2.298 in.
3.....	1.746 in.	2.114 in.	1.891 in.
4.....	1.761 in.	1.930 in.	1.702 in.
5.....	1.772 in.	2.211 in.	1.869 in.
Average....	**1.690** in.	**2.047** in.	**1.878** in.

Whitney-Kennedy .50, Solid Ball.

This arm is the third of the large .50-caliber weapons using both solid and express bullet. Its ammunition was taken from the same boxes used by the Winchester of the

same caliber, and all marks and figures on that ammunition apply to this. The cut of the cartridge used in the remarks

on the Winchester gives rather undue prominence to the bottle-necked feature of the shell. The cut herewith gives a more correct idea of the appearance of the shell. The shell itself is $1\frac{5}{6}$ inches in length. The arm weighed 8 pounds 11 ounces, and of this weight 3 pounds 8 ounces were in the barrel. It had a 26 inch octagonal barrel and was marked "Q. 95." The twist in the rifling was uniform, one turn in 30 inches, with six grooves, each .006 of an inch in depth. It was placed on the rest at 200 yards at half-past ten on the morning of Oct. 19, with the barometer standing at 30.205, the thermometer at 68.5, the wet-bulb thermometer at 64, indicating a dew point of 60.7 and a humidity of 76 per cent. The wind came from the seven o'clock quarter at a twelve-miles-an-hour pace. As in all the other express rifles particularly the traces of the gyratory motions by which the ball traveled from muzzle to target are noticed in the figures of the trajectory heights. The figures as reached are as follows:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.042 in.	11.246 in.	8.460 in.
2.....	7.067 in.	9.341 in.	8.446 in.
3.....	7.678 in.	11.474 in.	8.790 in.
4...	7.108 in.	11.096 in.	8.481 in.
5.....	7.690 in.	11.962 in.	9.146 in.
Average....	**7.517** in.	**11.024** in.	**8.665** in.

At the 100-yard range this rifle was tested on Oct. 10 with the ammunition taken from the Winchester box. The barometer at the time stood at 30.310, the dry thermometer at 62, and the wet bulb thermometer at 55, making a dew point of 48 and a humidity of 60 per cent. The wind came at 18 miles per hour from the 10 o'clock quarter. The results obtained appear somewhat startling, but careful verification of them and re-examination of the target shows that they are entirely correct, and that the course of each bullet in the series of five is most accurately noted. It affords one of the most marked cases of the existence of the gyratory motion on the part of the bullet. Why such a motion should exist we cannot now stop to consider. Whether it is due to

a certain relation between the powder charge and thereby the bullet velocity and the character of the rifling, or to other circumstances, is in some measure an open question. That there is such a motion our figures show; that such a motion is not confined to small arms is the experience of every one who has had much to do with ordnance of a larger type, where it is not unfrequent in experimental arms to see a conical solid shot go off in a long corkscrew course down the range, and then after traveling in that way for a distance seem to correct itself, and with the diminishing velocity regain a normal course and travel in the usual arc and in a single vertical plane. In the table below it will be observed that the third and fifth shots show trajectory points on the 50 and 75 yard screens actually below the line of fire. This would naturally lead to the conclusion that the shot was dropping, whereas the true explanation is found in the remarks above. The second shot shows the same law at work, only in this case the third or 75-yard screen caught the bullet at one of its upper arcs of travel, and a constantly rising bullet would seem to be the conclusion. Really there was nothing of the sort, as the bullet-hole in the target went to show. Under the circumstances we have calculated the average trajectory on the entire line of five shots, as follows:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.090 in.	1.842 in.	1.552 in.
2.....	1.798 in.	1.844 in.	2.781 in.
3.....	1.250 in.	—0.879 in.	—1.714 in.
4.....	2.149 in.	3.411 in.	3.533 in.
5.....	1.098 in.	—0.328 in.	—0.008 in.
Average....	**1.477** in.	**1.178** in.	**1.229** in.

Whitney-Kennedy .50, Express Bullet.

The trial of the Whitney-Kennedy with the light express bullet at 200 yards, followed immediately upon the completion of the solid bullet shooting by the same rifle at that range. The weapon was not taken from the rest, though

the barrel was cleaned by passing through the swab several times. The weather conditions it is not necessary to note again as they had not changed to any extent. For the report on the cartridge examined see the report on the Winchester .50 express bullet, as some from the same lot of cartridges were employed. The list of figures does not show in any such marked degree the vagaries seen in the case of the solid bullet, though the average at 150 yards would seem to be rather higher than one would expect. The record shows:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.145 in.	12.176 in.	9.769 in.
2.....	6.909 in.	11.013 in.	8.946 in.
3.....	7.240 in.	10.970 in.	9.009 in.
4.....	7.771 in.	11.072 in.	8.338 in.
5.....	8.938 in.	12.617 in.	9.464 in.
Average..	**7.800** in.	**11.569** in.	**9.105** in.

This rifle at 100 yards with the express bullet in it was fired at half past eleven o'clock on the morning of Oct. 10, and showed again the presence of this gyratory motion. In the record of several of the shots, particularly is it seen in the second round, which in the space between the 50 and 75 yard target dropped more than two inches. When the arm was tried the wind was blowing from the 10 o'clock quarter at the rate of 15 miles per hour. The barometer stood at 30.285 inches; the thermometer at 64.5 F.; the wet bulb at 55, giving a dew point of 45.7, and a humidity of just 50 per cent. For description of the ammunition see that described under Winchester .50, express, as also for cut of the light bullet. The results from the measurements of the screens and targets show:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.832 in.	2.673 in.	1.822 in.
2.....	1.380 in.	2.692 in.	.582 in.
3.....	1.849 in.	2.522 in.	2.134 in.
4.....	1.743 in.	2.311 in.	2.031 in.
5.....	1.814 in.	2.455 in.	1.580 in.
Average.....	**1.723** in.	**2.530** in.	**1.629** in.

Remington .50, N. Y. State Military.

This is the last of the .50-caliber rifles, and though not a hunting weapon was put upon the rest and subjected to a trial for trajectory as affording an interesting comparison with the expensive and specially adapted hunting arms making up the bulk of the list. It is not unusually used in field practice for game, especially in the rural sections of the State, and even in this city we recall a bit of very good work when Hoefle, of the 8th Regiment, and well-known to those who frequented Creedmoor in its earlier years, waited on bended knee for the approach of a mad bullock, tearing along a down-town street, and when the hot breath of the infuriated beast was almost in his face, pulled trigger, and a .50-caliber bullet went tearing open the bovine breast. The piece is slangily styled the "gas pipe" by the militia boys, but that now and then a good one is to be found in the lot issued to the regiments is evidenced in the figures below, which were taken from the trial of a gun loaned by General Robbins, State Inspector of Rifle Practice for the State, and one of the most enthusiastic, successful and careful students of rifle practice on the National Range. The weapon was marked on the butt-plate 28-H-55. It had a 36-inch round barrel and weighed 8 pounds 13 ounces without bayonet or sling. The rifling has a uniform twist of one turn in 42 inches, with five grooves each .005 of an inch deep and .16 of an inch wide. It was loaded with ammunition of the

Winchester make, selected by State Officers as the best adapted to the arm. The bullet is of pure lead and is set down as of 450 grains weight with 70 grains of powder behind. The bullet is a three-groove one. Examination of

three rounds found the powder in good condition and the weights at 71.2, 69 8 and 70 grains respectively, while the corresponding bullets weighed 450.8, 450.3 and 449.3 grains.

The weapon was put on the rest for the 200-yard test at 10:15 o'clock on the morning of Oct. 1, with the wind blowing in gusts at an average of about eight miles per hour from the one o'clock quarter. The barometer stood 30.150 inches, the thermometer at 76 F., the wet-bulb thermometer at 67 and the dew point at 61, with 60 per cent. humidity The rifle had been fired thousands of times before, and though old and rusty without showed that it had a good and trusty barrel, making a record as follows:

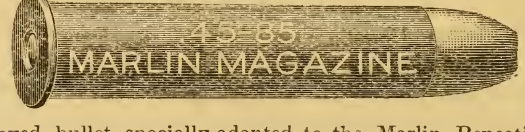
Round.	50 Yards.	100 Yards.	150 yards.
1.....	10.212 in.	13.850 in.	10.589 in.
2.....	10.094 in.	13.728 in.	10.885 in.
3.....	10.068 in.	13.664 in.	10.499 in.
4.....	9.754 in.	13.262 in.	10.276 in.
5.....	10.122 in.	13.672 in.	10.402 in.
Average ...	**10.050** in.	**13.635** in.	**10.530** in.

It was not until half past four on the afternoon of Oct. 12 that the rest was clear for the Remington State at 100 yards, and it was then tried under wind blowing at 19 miles per hour from the 2 o'clock quarter. The barometer stood 30.290, the thermometer 54.5, the wet bulb thermometer 50 5 and the dew point 46.5 with 51 per cent. humidity. The ammunition was same as used at 200 yards, and the weapon surprised its friend by its steadiness. It is to be regretted that more care was not taken and every weapon in the hands of the volunteers able to shoot as well. The record stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.298 in.	2.922 in.	2.393 in.
2.....	2.290 in.	2.935 in.	2.395 in.
3.....	2.385 in.	3.049 in.	2.524 in.
4.....	2.438 in.	3.100 in.	2.605 in.
5.....	2.251 in.	2.927 in.	2.429 in.
Average....	**2.332** in.	**2.986** in.	**2.469** in.

Marlin .45.

The Marlin .45 at 200 yards was put on the rest Sept. 29, nearly at the opening of the trials, at about half past eleven in the morning. The wind was blowing from the 10 o'clock quarter at seven miles an hour. The barometer indicated 30.120, the dry thermometer 77.4 and the wet-bulb thermometer 67.6, making the dew point 61.4 and the humidity of the atmosphere 58 per cent. The arm weighed 9 pounds 11 ounces, with a barrel weight of 3 pounds 11 ounces, barrel 28 inches in length, octagonal and marked on the top ".45 Govt.," while the shop number was 9449. It had a uniform twist of rifling 20 inches to the turn, 6 grooves .003 in depth and .158 inches in width each. It was loaded with U. M. C. ammunition from a box purchased from the stock of the Marlin Arms Company agency in this city. The box of ammunition was marked ".45-cal., 85 grains, 285 grains



grooved bullet, specially adapted to the Marlin Repeating Rifle." Three of the cartridges were opened and examined, and the powder behind the two grooved bullets found in fine condition. The three charges weighed 84.3, 84.9 and 83.4 grains respectively, while the corresponding bullets were 290.5, 289.7 and 289.4 grains.

The arm acted in a very contrary manner in the rest, and with a consumption of over 25 rounds it was only possible to get one shot through all the screens and on the target. The weapon was several times cleaned and particular attention paid for any traces of leading in the barrel, but none were detected, yet the arm threw the bullets now high, now low, in every and various directions, and at one shot sending a deflected bullet very near our esteemed carpenter's head. An attempt was made to insert a Govern-

ment cartridge, but the 500-grain bullet refused to go into the chamber or rifling, and we were forced to be content with a single trajectory curve instead of the average of five which was desired. This curve showed:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	**7.596** in.	**11.236** in.	**9.019** in.

At 100 yards the rifle was tested on Oct. 10, about 2 o'clock in the afternoon, with the wind coming from the 9 o'clock quarter at an 11 miles per hour rate, the barometer stood 30.200 inches, the dry thermometer at 62.5 and the wet-bulb thermometer at 58, making a dew point of 54.9 and indicating a humidity in the atmosphere of 76 per cent. Again the arm acted very obstinately and but one satisfactory round was put through the screens out of the score or more fired. This round showed a curve as follows:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	**1.131** in.	**2.125** in.	**1.612** in.

Winchester .45.

The arm at 200 yards was tried on Sept. 28 at 4:40 P. M., with a five mile and half breeze blowing from the 6 o'clock quarter. The dry thermometer indicated 65.7, the wet-bulb thermometer 59 and a dew point of 51.8, and humidity, 58 per cent., was calculated from this. The barometer reading was 30.210 inches. The arm weighed 10 pounds 8 ounces and the barrel alone 3 pounds 10 ounces. The barrel's length was 30 inches, octagonal and numbered 48,005. There are 6 grooves having an uniform twist of 30 inches to the turn and a depth of .003 inches with a width of .142 inches. It was loaded with Winchester-made ammunition

from box marked ".45 caliber, 75 grains powder, model Centennial, 1876." A bottle-neck shell 1⅞ inches in length, having a three-grooved naked bullet, when examined, three

rounds turned out the powder in fine condition. The three powder charges weighed 77.6, 75.7 and 76 grains, while the bullets, made up of 1 part tin to 16 of lead, weighed respectively 349.3, 349.5 and 349 6 grains. In the rest the arm behaved well and showed a record as follows:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.071 in.	11.272 in.	8.855 in.
2.....	8.657 in.	12.070 in.	8.526 in.
3.....	9.332 in.	13.002 in.	10.097 in.
4.....	8.587 in.	12 033 in.	9.385 in.
5.....	8.312 in.	11.517 in.	8.931 in.
Average.....	**8.592** in.	**11.979** in.	**9.359** in.

At 100 yards the test was made on Oct. 5, with a wind coming from the 8 o'clock quarter at thirteen miles per hour. It was at 12:45 when the rifle was put in the rest, the barometer reading 30.150 inches, the thermometer 60 and the wet-bulb thermometer 52, making a dew point of 43 and the humidity in the atmosphere at 54 per cent. Similar ammunition to that at 200 yards was used. The score stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.053 in.	2.696 in.	2.317 in.
2.....	2.044 in.	2.530 in.	2.175 in.
3.....	1.920 in.	2.452 in.	2.107 in.
4.....	1.919 in.	2.382 in.	2.089 in.
5.....	2.048 in.	2.603 in.	2.108 in.
Average.....	**1.997** in.	**2.532** in.	**2.159** in.

Bullard .45.

This rifle, at the 200-yard range, was tested on Sept 29 at about 10 o'clock in the forenoon, and when placed on the stand a lazy wind, going at the rate of three miles an hour, was passing over the range from the 4 o'clock quarter. The barometer stood at 30.250 inches, the dry thermometer at 73.5°, the wet bulb at 68°, making a dew point of 64.5, and the atmospheric humidity at 73 per cent. of complete saturation. The weapon had a 26-inch, half-octagon barrel, and was numbered 724. It weighed 9 pounds 14 ounces, and the barrel alone is given as weighing 3 pounds 6 ounces. There are five grooves, with uniform twist of one turn in 30 inches,

The depth of rifling is .004 and the width of groove .160. The loading was from a box marked ".45-cal., 85grs. powder, for the Bullard, Marlin and other rifles," coming from the works of the Union Metallic Cartridge Company.

Three rounds of the ammunition when opened showed the powder in fine condition and the bullet having two grooves. The charge was of FG powder, either Laflin & Rand's or Dupont's, as both are used by the U. M. C. Co., and the bullets had 1 tin to 20 lead. When weighed the charges of powder ran 84.3, 84.9 and 83-4, while the corresponding bullets were 290.5, 289.7 and 289.4 grains.

The weapon acted well in the rest and gave the following record:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	7.839 in.	11.252 in.	8.817 in.
2.....	7.892 in.	11.377 in.	8.811 in.
3.....	7.729 in.	11.258 in.	8.975 in.
4.....	7.591 in.	10.822 in.	8.484 in.
5.....	7.579 in.	10.925 in.	8.551 in.
Average.....	**7.726** in.	**11.127** in.	**8.727** in.

At 100 yards the trial was on Oct. 5, at 3 o'clock in the afternoon, with the wind coming from the 8 o'clock quarter at a 11-mile per hour rate. The barometer recorded 30.220, the thermometer 60.5, the wet-bulb thermometer 53, making the dew point 45.7 and indicating a humidity of 59 per cent. It is unnecessary to give again the detail of the charge used, which was similar to that at 200 yards. The figures show trajectory heights of follows:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.745 in.	2.210 in.	1.831 in.
2	1.808 in.	2.258 in.	2.015 in.
3.....	1.684 in.	1.975 in.	1.661 in.
4.....	1.902 in.	2.379 in.	2.013 in.
5.....	1.819 in.	2.241 in.	1.936 in.
Average.....	**1.791** in.	**2.210** in.	**1.891** in.

Springfield .45 Military.

This weapon is the regular army weapon of to-day with its three grooves and the later adopted cartridge having the 500-grain bullet. It was one which had long been on the range, brought there, we believe by Major Shorkley, and presented to Gen. Wingate in replacement of one which the Major had shortened down an inch at a time into horse pistol length, while trying some of the interesting experiments in which he finds so much of instructive entertainment. It was put on the rest for the 200 yards testing on the afternoon of Oct. 1, about 3 o'clock, the wind at that time blowing down the range from the 6 o'clock quarter at seven miles per hour. The barometer showed 30.075 inches, the thermometer 73.2, the wet-bulb thermometer 61, showing a dew point of 50.8, and an atmosphere having 45 per cent. of humidity. The weapon itself weighing 8 pounds 11 ounces, with a barrel of 3 pounds 9 ounces weight. The length of the round barrel is 32 inches and the rifling is uniform with three grooves of 22 inches to the full turn. Depth of groove .005 and width of groove .235. It was loaded with ammunition made according to the shell inscription at Frankford Arsenal, near Philadelphia, in February, 1884. The charging then was the same as it has been for four years past, with Dupont's "musket," now called "small-arms" powder. The bullet has a composition of 16 lead to 1 of tin by weight.

The opening of three charges showed the powder pressed hard but in good condition, and the bullet with three broad grooves. The charges of powder when weighed turned the balances at 69.6, 69.3, and 69.7 grains, while the three corresponding bullets weighed 499.2, 499.4, and 499.5 grains.

The rifle seemed at home in the Government rest in which

it found itself, and light though the barrel was, there is no signs of anything but very steady shooting. The record standing:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.983 in.	12.224 in.	9.417 in.
2.....	9.654 in.	13.315 in.	10.169 in.
3.....	9.582 in.	13.261 in.	10 079 in.
4.....	9.304 in.	12.925 in.	10.009 in.
5.....	9.509 in.	13 209 in.	10.106 in.
Average.....	**9.406** in.	**12.987** in.	**9.956** in.

At 100 yards the trial was made on Oct. 12, with the wind coming from the 2 o'clock quarter at the rate of 18 miles per hour. The barometer stood 30 290 inches, the thermometer 54.5°F., the wet-bulb thermometer 50.5, making the dew point 46.5 and the humidity 51 per cent. Again the rifle was on its good behavior in the rest, though the figures will bear careful scrutiny, and show that as a military arm it is close enough as a shooter to do very great execution in skillful hands. The 100-yard score stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.290 in.	2.834 in.	2.492 in.
2.....	2.291 in.	2.915 in.	2.458 in.
3.....	2.372 in.	2.952 in.	2.488 in.
4.....	2.321 in.	2.882 in.	2.397 in.
5.....	2.353 in.	2.888 in.	2.435 in.
Average.. .	**2.325** in.	**2.894** in.	**2.454** in.

Sharp .45.

This weapon was a well rusted veteran, and had for eight years been carried by one of the FOREST AND STREAM'S staff in every part of the West. It had done capital service at antelope, elk and mountain sheep, and it had shown itself a hard and a close hitter. It carried a Government cartridge of the 405-grain bullet model, and with this it was tested. The weapon had a 30 inch round barrel and was numbered 162,275, and was provided with a set trigger. It weighed 10 pounds 3 ounces and the barrel weighed 5 pounds 4 ounces. It had a uniform rifling, six grooves, with one turn in 20 inches the depth of rifling was .003 and the width about .120 inch. It was placed in the rest Oct.

19, about noon, with the wind coming 21 miles per hour from the 7 o'clock quarter. The barometer at 30.195 inches, the thermometer at 70.5 and the wet-bulb thermometer at 64.5, giving a dew point of 60.5 and indicating a humidity of 71 per cent. The ammunition employed was of the Union

Metallic Cartridge Company's manufacture, with a composition in the bullet of 1 tin to 14 lead and loaded with FG powder. When opened the powder was found hard pressed but in fair condition, and the bullet had the regulation three broad grooves. The weights of the three powder charges were 72 4. 71.3 and 69 1 grains, while the corresponding bullets were 404.5, 404 2 and 404.5 grains. The record at the 200-yard range stood:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.188 in.	10.968 in.	8.464 in.
2.....	8.540 in.	11.937 in.	8.906 in.
3.....	8.917 in.	11.760 in.	9.098 in.
4.....	8.399 in.	11.706 in.	8.867 in.
5.....	8.623 in.	11.928 in.	9.130 in.
Average	**8.533** in.	**11.659** in.	**8.893** in.

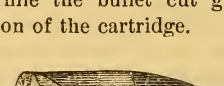
The 100-yard shooting of the Sharp rifle had been tried on Oct. 10, about half-past 4 in the afternoon, with the wind coming across the range from the 9 o'clock quarter with a 5 mile an hour velocity. The other observations were: Barometer 30.220 inches, thermometer 64°F., wet-bulb thermometer 56°, and a dew point of 49 with a humidity of 58 per cent. Again the old Sharp proved itself a tractable weapon, and a single sighting shot put it on the bullseye, and then the five trial shots showed the following record:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.865 in.	2.597 in.	2.336 in.
2.....	2.067 in.	2.585 in.	2.157 in.
3.....,	2.068 in,	2.545 in.	2.128 in.
4.....	2 096 in.	2.568 in.	2.185 in.
5.....	2.312 in.	2.805 in.	2.345 in.
Average....	**2.081** in.	**2.620** in.	**2.230** in.

Bland .45, Double Barrel.

The English express rifle came to the test from Thomas Bland & Sons, through Major W. H. Merrill, to whom it had been sent for testing purposes by the makers. It was said that it was the identical rifle employed in the *Field* trial of two years ago, and about the results of which so much discussion had followed. The arm reached the range on Sept. 29. and was brought by Mr. G. J. Romer, on behalf of Maj. Merrill. In appearance it looked rather light for such heavy charges to which it was subjected and for which it was chambered. The weather conditions at the time of the 200-yard test, on the afternoon of the day named, were very favorable, the wind was from the 7 o'clock quarter, blowing seven miles per hour, the barometer stood 30 150 inches, the dry thermometer at 75°, and the wet-bulb thermometer at 68.5°, making a dew point of 64 5 and the humidity 70 per cent. The weapon weighed eight pounds thirteen ounces and the barrels alone when disconnected from the stock five pounds eight ounces, the barrel length being twenty eight inches. The twist appeared to be uniform with six grooves, making one turn in thirty-six inches. The groove base was not concentric with the bore of the weapon but was of peculiar shape, deep in one side and slight in another, being the ratchet groove. It would average about .007 inch in depth, while in width it was about .20 inch. The shop number on the arm was 10,263. It was loaded with ammunition brought by Mr. Romer and said by him to have been sent over with the arm. They were Eley Brothers cartridges, marked on the back of the cartridge head "Eley No. 1 Expr.," and the bullet a solid one with

patch, was marked with a small M on the base. The powder was Curtis & Harvey, No. 6, and one of the cartridges when turned out for measurement showed the powder in fine condition with a 310.1 grain bullet and 113.3 grains of powder. It is impossible to say what the bullet composition is as no test was made of it. The arm is of the tip-up shotgun pattern, and no small trouble was met in getting it so fitted to the rest that the muzzle height could be taken with exactitude at each discharge. The cut will show the size of cartridge used, while the bullet cut gives the size and shape of that portion of the cartridge.



In numbering the shots care was taken to note the right-hand barrel shots from those of the left-hand barrel. The right hand barrel was in each case fired first, followed by the other barrel, making the odd-numbered shots belong to the former and the even-numbered ones to the latter. The right-hand barrel record stood as follows:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	5.017 in.	7.236 in.	5.720 in.
3.....	4.544 in.	7.250 in.	5.519 in.
5.....	5.023 in.	7.635 in.	5.965 in.
9.....	5.160 in.	7.778 in.	6.141 in.
Average.....	**4.936** in.	**7.475** in.	**5.836** in.

Of course the conditions in every respect were the same for the other barrel, whose record stood:

Round.	50 Yards.	100 Yards.	150 yards.
4.....	4.901 in.	6.941 in.	5.242 in.
6.....	5.450 in.	7.932 in.	5.959 in.
8.....	4.993 in.	7.378 in.	5.914 in.
10.....	5.199 in.	8.093 in.	5.885 in.
Average ...	**5.136** in.	**7.586** in.	**5.750** in.

The average of both barrels and for the rifle gives us:

	50 Yards.	100 Yards.	150 Yards.
Right barrel.....	4.936 in.	7.475 in.	5.836 in.
Left barrel.....	5.136 in.	7.586 in.	5.750 in.
	5.036 in.	**7.530** in.	**5.793** in.

It will be seen that the two barrels are very uniform in results, and at the subsequent tests at 100 yards the right-hand barrel only was used. This enabled closer grouping on the screens and targets, while it did not work any disadvantage to the gun or trial.

Mr. Romer came again with the bag in which the Bland was tucked away on Oct. 12, and about 11 o'clock A. M. it was given the test at 100 yards. He complained that the gun had shown signs of weakness after taking from the rest on the 29th ult.; at least when he got home he found the upper tang which fastens the metal work of the arm to the wooden part of the stock had sprung; he had accordingly constructed a special rest in which wooden clamps were closely fitted over the barrel at two points, they in turn fastened to a thin metal plate, which slid in grooves or guides, fastened to a broad base. With this contrivance, very simple and ingenious, and very quickly fitted, we were enabled to get the measurements of the muzzle at the moment of pulling the trigger, while the arm was free to follow the natural motion of recoil, and slide back to be grasped by the hand of the firer. In noting the figures made under these conditions, due allowance must be made for whatever advantage this system of rest may be thought to afford the weapon under trial.

The weather observations at the time of the 100-yard trial of the Bland showed a barometer of 30.320 inches, dry thermometer 59.5°, wet-bulb thermometer 55°, dew point 50.5 and humidity 72 per cent. The wind was coming from the 7 o'clock quarter at 12 miles an hour velocity. The cartridges for this test were from a lot of express-bullet ones sent over from the Eley cartridge works to a gun shop in this city and which after much inquiry we were fortunate enough to get. Mr. Romer had used up most of the original supply of bul-

lets, and though he had shells and powder to reload, it would have been necessary to send to England for bullets, and the time for this we could not afford. The purchased lot turned out to be very excellent ones; they were in cartridge shells marked as before—"Eley No. 1 Expr."—and three of them turned out the powder in fine condition, the bullets were patched and had the usual hollow point covered in with a brass lid. This inserted tube of brass has a rounded point corresponding with the outline of the bullet. Three charges when weighed showed powder weights of 111.8, 112.4 and 112 grains, and corresponding bullets of 277.4, 277.7 and 277.2. This would give the very high proportions of nearly 1 to 2, and of course very swift moving bullets and low trajectory was the rule. Mr. Romer, as an old rifleman, did not take kindly to the idea of shooting patched bullets through a dirty barrel, so the first five rounds after the sighting shots were fired with the swab passed through the barrel after each round. The record stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.278 in.	1.429 in.	1.283 in.
2.....	1.330 in.	1.546 in.	1.378 in.
3.....	1.308 in.	1.615 in.	1.169 in.
4.....	1.150 in.	1.376 in.	1.364 in.
5.....	1.219 in.	1.368 in.	1.329 in.
Average.....	**1.257** in.	**1.466** in.	**1.304** in.

Now we said, as this is a test of hunting rifles and a hunting rifle ought to be one capable of reasonably long use without cleaning, we will fire five trial shots without cleaning. This was next done and the record of this test stood:

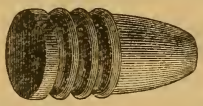
Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.146 in.	1.373 in.	1.298 in.
2.....	1.159 in.	1.304 in.	1.247 in.
3.....	1.219 in.	1.415 in.	1.352 in.
4.....	1.270 in.	1.364 in.	1.301 in.
5.....	1.084 in.	1.216 in.	1.217 in.
Average.....	**1.175** in.	**1.334** in.	**1.283** in.

Out from the recesses of his shooting trap box Mr. Romer

fished a half dozen cartridges. They were some which he had himself loaded with C. & H. No. 6 powder and some of the same bullets as before mentioned in the 200-yard test. One cartridge taken and opened showed 107.5 grains of powder in fine condition behind a 309.7 bullet and jute wad between. The wind by this time had increased in force until it was recorded as blowing 23 miles per hour, but from the same quarter. The record of the five shots showed:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.082 in.	1.399 in.	1.215 in.
2.....	1.140 in.	1.557 in.	1.383 in.
3.....	0.964 in.	1.328 in.	1.215 in.
4.....	1.132 in.	1.544 in.	1.355 in.
5.....	0.944 in.	1.222 in.	1.248 in.
Average.....	**1.052** in.	**1.410** in.	**1.283** in.

We regretted that we we were not able to make more exhaustive tests with this imported arm of a class for which so much is claimed and which is held in such high esteem. Had not the supply of shells been expanded by the tests already made we should have liked to load a few with the naked bullet made for them and fired a set of test shots. This grooved bullet is shown in the cut, and if report be

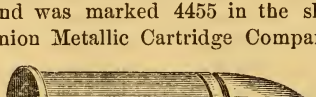


true, is a very low-shooting, hard-hitting one, but with such a charge of such quick-burning powder it could hardly be otherwise.

Wesson .44, Rim-Fire.

This arm is the first of those using the rim-fire cartridge, and the only one in the trial of the .44 caliber. We have seen what the .50 caliber weapons were capable of; also an interesting group of .45; and now we come to a solitary example of the caliber so popular among the small-bore, long-range rifles at one time. The form of this old-time well-known rifle is familiar to all, with its tip-up barrel,

which made it a very unhandy one for placing in the rigid rest we had in use. It did not come from the factory of Mr. Wesson, as repeated letters had failed to bring a response in the form of an express package containing a rifle. We accordingly sent to the shop of Mr. Henry C. Squires, 178 Broadway, and selected from his stock a Wesson for the trial. The ammunition also was procured there. The arm weighed 8 pounds 6 ounces, had an octagonal barrel 30½ inches long, and was marked 4455 in the shop. It was loaded with Union Metallic Cartridge Company's ammuni-



tion of the .44-28-214 pattern. Three rounds opened showed the FG powder in fine condition and a pure lead bullet with one groove. The powder weights of the three charges were 27, 28.9 and 28.5 grains, while the three corresponding bullets were 213.9, 214.2 and 214.8 grains in weight.

The 200-yard test was made on Sept. 30, at 3 o'clock in the afternoon, with the barometer at 30.02 inches, the dry thermometer at 77.2°, the wet-bulb thermometer at 66.5°, making the dew point 59 and the humidity 54 per cent. The wind came from the 6 o'clock quarter at 16 miles per hour.

The record at this range stood:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	14.496 in.	19.981 in.	15.101 in.
2.....	13.563 in.	18.755 in.	14.297 in.
3.....	13.419 in.	18.224 in.	13.885 in.
4.....	14.021 in.	18.904 in.	14.419 in.
5.....	14.393 in.	20.201 in.	15.442 in.
Average....	**13.979** in.	**19.213** in.	**14.628** in.

It was not until Oct. 12, at 3 o'clock P. M., that the arm was put on for the 100-yard test. The wind was coming then from the 8 o'clock quarter at 16 miles per hour. The barometer indicated 30.320 inches, the thermometer 53.5°, the wet-bulb thermometer 50.5°, giving the dew point 47.5 and a

humidity of 80 per cent. The ammunition was as before, and the trial showed:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	3.535 in.	4.651 in.	3.773 in.
2.....	3.608 in.	4.584 in.	3.690 in.
3.....	3.127 in.	4.124 in.	3.499 in.
4.....	3.603 in.	4.536 in.	3.793 in.
5.....	3.624 in.	4.768 in.	3.898 in.
Average.....	**3.499** in.	**4.532** in.	**3.730** in.

Merrill Muzzleloader, .42.

We have styled this the Merrill muzzleloader because it was owned and furnished by Major H. W. Merrill, with whom, as a writer on the question of muzzle vs. breech and other topics connected with the science of rifle shooting, our readers are already well acquainted. The weapon was made by E. Phillips, once well known in New York, and was brought and fired by Mr. G. J. Romer, and we are sorry that it was put through the 100-yard test only. This was in accord with the special desire of the Major that it should be tested at 100 yards.

The Merrill arm was a type of the old time weapon, when 40-rod shooting was considered the very highest form of the art of marksmanship. It weighed entire 11 pounds 6½ ounces, and had an octagonal barrel weighing 8 pounds 6 ounces. It was provided with set trigger, and had globe and peep sights for either target or hunting work. The barrel was 28 inches in length. The caliber was .42-inch and the rifling of the gain twist pattern, starting in at the breech end with one turn in 72 inches, and finishing at the muzzle with the rate of one turn in 24 inches, averaging one turn in 34 inches. There were 6 grooves, each .010 inches deep, and .105 inches in width. The loading was done in the ordi-

nary way with a metal starter, using a jute wad and an oiled

linen patch for the bullet. The loading was with Curtis & Harvey's No. 6 powder and this small conical bullet, mould cast by Mr. Romer of 20 parts lead to 1 of tin. The powder charge weighed 98 5 grains, while two bullets weighed up respectively to 212.7 and 213.1 grains. It was loaded as was the Romer weapon, and, like it, was slow and sure in manipulation. It was not put in the iron rest, but was provided with the barrel-grasping clamp and fired in such way from a dead rest that at each discharge it was free to slide in recoil. It was, in fact, tried as was the Bland, at 100 yards, and the same allowance, if any, must be made in judging its results. When tried it was about 2 o'clock on the afternoon of Oct. 12. The barometer stood at 30.300 inches, the dry thermometer at 58°, the wet-bulb ditto at 54°, making, by calculation, a dew-point of .50 and a humidity of 75 per cent. The wind at the time came from the 5 o'clock quarter at the rate of 18 miles per hour. With such a charge from such a weapon the shooting was, of course, very accurate, and a very flat line of fire is shown. Special care was taken with the measurements of the muzzle heights at each replacement of the weapon in the rest. Of course it was able to make a very close group of shots on the target, but it will be understood that an accuracy test and a trajectory test are two utterly distinct matters, and that they ought to be carried on under different conditions. No one with any knowledge of the action of small arms under fire would for a moment think of getting a test of accuracy from a rigid rest, while for a trajectory test, where it is essential to have a zero point on the muzzle at the moment of firing, something in the form of a rest which will secure that is absolutely necessary. Sandbags and a good marksman come into play where accuracy is needed, but for trajectory, as long as the bullets pass through the screens and reach the target we have all that is needed to calculate the trajectory height. Any attempt to unite the two in the same round must of course be futile. In such a case as the present the inch broad black patch on the 50-yard screen might easily have been hit with each shot, almost any rifle in the trial would have done that,

but here as in other cases, the aim was purposely held off in order that clear and separate punctures in the screens might be made and readily noted and easily measured. The record of the Merrill rifle stood as follows:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.180 in.	1.373 in.	1.270 in.
2.....	1.239 in.	1.498 in.	1.205 in.
3.....	1.033 in.	1.399 in.	1.419 in.
4.....	1.170 in.	1.051 in.	1.051 in.
5.....	1.031 in.	1.210 in.	1.421 in.
Average....	**1.130** in.	**1.306** in.	**1.273** in.

Romer Muzzleloader, 42.

This weapon is named, as was the last, after the gentleman who brought it to the test; but in this case it was the maker as well. The rifle came down on Sept. 29, when the Bland was brought for the 200-yard trial, and had a 200-yard test only. It was a ponderous weapon, weighing, complete, 14 pounds 2 ounces, and with a 27-inch octagonal barrel. in which there was 11 pounds 12 ounces of metal. The caliber was .42 inch, and with six grooves, each .010 inch deep and .105 inch wide. The twist was gain, starting in at 72 inches to the turn and reaching the muzzle at 24 inches to the turn, averaging one turn in 34 inches. The loading was done in the ordinary way with a false muzzle, using a jute wad and an oiled linen patch for the bullet. The powder used was Curtis & Harvey No. 6, and two charges taken at random during the loading showed powder weights of 133 25 and 131.10 grains, while two of the conical bullets

taken at random out of the box weighed 267.2 and 267.3 grains. They were cast in mould by Mr. Romer, using 20 parts lead to 1 of tin.

When the weapon was tried at 200 yards on Sept. 29 from

the rigid rest, the wind was coming from the one o'clock quarter at 4 miles per hour. The barometer stood at 30.150, the dry thermometer stood at 69°, the wet-bulb thermometer at 65.2°, making a dew point of 62.4 and the humidity 79 per cent. of saturation. Its record stood:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	4.333 in.	6.453 in.	4.997 in.
2.....	4.392 in.	6.492 in.	5.046 in.
3.....	4.342 in.	6.212 in.	4.876 in.
4.....	4.564 in.	6.504 in.	5.071 in.
5.....	4.363 in.	6.335 in.	4.977 in.
Average.....	**4.499** in.	**6.399** in.	**4.993** in.

Before dismissing the muzzleloaders we would say that we share the regret expressed by those who witnessed the tests, and since repeated by others, that this class of arm was not more numerously represented. That one to one charge, powder and lead, so interesting and so much discussed, ought to have been placed on record beside the figures made by the many breechloaders. Then, again, there is that large class of marksmen who have such an abiding faith in the round ball as against the bolt or conical missile. Our invitation to put rifles in the test was broad enough, and we would have extended the testing days until all weapons were tried. If the muzzle men did not come forward and face the test, they have only themselves to blame for the omission of their rifles from our catalogue.

Marlin .40.

This arm was tried at 200 yards, on Sept. 30, with good weather conditions prevailing. It was put on at 7:30 in the morning, with the barometer standing at 30.150, the dry thermometer at 71.2°, and the wet-bulb thermometer at 65°, giving a dew point of 62.4 and the humidity 70 per cent. of saturation. The wind came from the 12 o'clock quarter at four miles per hour. The arm had an octagonal barrel 28 inches long, and had a total weight of 11 pounds 1 ounce, while the barrel weight is given as 5 pounds 1 ounce. It

was numbered 11,236. The rifling had a uniform twist of one turn in 20 inches, 6 grooves, and the grooves were each .003 inch in depth, and .153 inch in width. The loading was

with Union Metallic Company ammunition of FG powder, either of Laflin & Rand or of Dupont make. It was nominally .40-60-260. Three charges opened found the powder in fine condition, gave the weights as 64., 64.4 and 64.5., while the three corresponding three-grooved bullets were 259.3, 259.4 and 259.2 grains, the length of shell being $2\frac{1}{10}$ inches. The trajectory record stands:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	7.581 in.	10.931 in.	8.549 in.
4.....	8.514 in.	12.118 in.	9.294 in.
5.....	8.065 in.	11.541 in.	8.827 in.
6.....	8.067 in.	11.585 in.	8.919 in.
8.....	8.393 in.	11.945 in.	9.247 in.
Average..	**8.120** in.	**11.625** in.	**8.967** in.

The 100-yard trial came on about 10 o'clock on the morning of Oct. 10, with the barometer standing at 30.285, the thermometric reading being 60° on the dry and 53.5° on the wet-bulb instrument. This would give a dew point of 46.8 and a humidity of 62 per cent. The wind was coming at ten miles per hour from the 10 o'clock quarter. With the same rifle and similar ammunition to that already noted the trajectory record stands:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.940 in.	2.391 in.	1.950 in.
2.....	1.930 in.	2.430 in.	2.126 in.
3.....	2.011 in.	2.447 in.	2.138 in.
4.....	2.004 in.	2.476 in.	2.139 in.
5.....	2.072 in.	2.521 in.	2.171 in.
Average....	**1.991** in.	**2.453** in.	**2.104** in.

Ballard .40-70.

This arm is one of the fine close-shooting patched-bullet weapons, and, so far as compact bunching of the shots on the target, seemed to be fully equal to the high charged muzzleloaders in the test. The arm was marked .40 63, but the cartridges used were of the Winchester make and marked .40-70-330. It had an octagonal barrel, 30 inches long and weighing 6 pounds, while the entire piece weighed 10 pounds 3½ ounces. The shop number was 23,247. The loading, as above stated, was with Winchester ammunition, and the powder in the charges examined was in fine condition. It was of the regular Winchester brand, while the bullet had a composition of 20 parts lead to 1 of tin. The powder weights of three charges were 69.8, 70.2 and 68.6 grains, while the bullets ran 330, 330 and 330 grains exactly. The shell is 2⅜ inches in length.

The 200-yard test was made on Sept. 30 about 5 o'clock in the afternoon, with a barometric pressure of 30.003 inches, a dry thermometer at 72° and the wet-bulb ditto at 65°, giving dew point 60 and humidity 66 per cent. The wind, at 12 miles per hour, was coming from the 1 o'clock quarter. The record at this range showed:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.128 in.	11.318 in.	8.506 in.
2.....	7.870 in.	11.050 in.	8.348 in.
3.....	7.938 in.	11.078 in.	8.381 in.
4.....	7.578 in.	10.697 in.	8.038 in.
5.....	8.048 in.	11.205 in.	8.449 in.
Average.....	**7.912** in.	**11.069** in.	**8.344** in.

The 100-yard trial came in the morning hours of Oct. 10,

with the barometer at 30.315 inches, the dry thermometer at 58.5°, the wet-bulb thermometer at 55°, giving the dew point at 51.5 and the humidity 78 per cent. Wind velocity 8 miles per hour, from the 4 o'clock quarter. With ammunition as before the arm gave the following record:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	2.077 in.	2.513 in.	2.160 in.
2.....	2.082 in.	2.539 in.	2.142 in.
3.....	1.934 in.	2.388 in.	2.067 in.
4.....	2.023 in.	2.455 in.	2.111 in.
5.....	1.882 in.	2.365 in.	2.103 in.
Average....	**1.999** in.	**2.452** in.	**2.116** in.

Ballard .40-85.

This is another of the patched bullet weapons, and with one of the heaviest fixed charges for its bore. It has a 32-inch octagonal barrel, and was numbered 21,257. The gun weight was 10 pounds 15 ounces, and the barrel-weight is reported at 6 pounds 11 ounces. There are six grooves having a uniform twist of one turn in 20 inches. The grooves having a width of .003 inch, and the depth .153 inch. The ammunition was of U. M. C. make, marked as .40-85-370, having a $2\frac{15}{16}$-inch shell, with FG powder, and bullet a composition of 20 lead to 1 of tin. The powder turned out of the opened cartridges in fine condition, and weighed in the three tested 90, 89 1 and 89.6 grains, while the bullet weights corresponding were 369.3, 369.3 and 369.3. No cartridge cut seems necessary in this case, except for extra length, the cartridge being similar to the .40-70 above. The trajectory record speaks for itself; it stands:

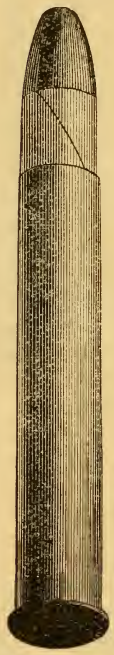
Round.	50 Yards.	100 Yards.	150 Yards.
1.....	6.819 in.	9.679 in.	7.272 in.
2.....	7.049 in.	9.890 in.	7.439 in.
3.....	7.211 in.	10.148 in.	7.780 in.
4.....	7.087 in.	9.881 in.	7.380 in.
5.....	7.020 in.	9.867 in.	7.381 in.
Average..	**7.037** in.	**9.893** in.	**7.450** in.

At 100 yards the trial of this arm was made on Oct. 10 at noon, with the wind coming eleven miles an hour from the 4 o'clock quarter. The other weather conditions were: Barometer, 30.240; thermometer, dry, 62°, and wet-bulb 57°,

making the dew point by simple calculation 50, and the humidity 50 percent. of atmospheric saturation. The ammunition, of course, was the same as before, and the record stands:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.693 in.	2.107 in.	1.795 in.
2.....	1.659 in.	2.012 in.	1.827 in.
3.....	1.721 in.	2.020 in.	1.765 in.
4.....	1.661 in.	2.109 in.	1.841 in.
5.....	1.806 in.	2.058 in.	1.879 in.
Average....	**1.708** in.	**2.061** in.	**1.821** in.

Remington-Hepburn .40.



Another of the patched-bullet arms, made for fine target groupings, and like each of its class having a strong following among riflemen. The convenient side snap action introduced by Mr. Hepburn makes it a ready weapon to place in the rest, and the steadiness of the work goes to show that a fixed rest is not so prejudicial to the merits of an arm as some believe. It was of course tried without any cleaning between the shots. The weapon had a 30-inch barrel numbered 4,321. Its weight was 11 pounds and 2 ounces, and of the barrel 7 pounds 1½ ounces. It used a 2½ inch shell of the Remington make. The powder, of the FG Hazard brand, when three cartridges were opened came out in good condition, and the powder charges weighed 65.1, 65 and 65.5 grains, while the bullets weighed 322.7, 322.5 and 326.2 grains, and in composition were 20 of lead to 1 of tin. The rifle had five grooves with uniform twist of one turn in 20 inches, the grooves being .0035 inch deep and .160 inch in width. The test at 200 yards was made on Sept. 29 at 11 o'clock in the forenoon, the wind coming at six miles per hour from the 5 o'clock quarter. Dry thermometer stood at 73.5°, wet-bulb thermometer at 67°,

making a dew point of 62.8 inches and the humidity record 69 per cent. of saturation. The trajectory heights stood:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.527 in.	11.930 in.	9.047 in.
2.....	8.438 in.	11.799 in.	8.994 in.
3.....	8.702 in.	12.360 in.	8.237 in.
4.....	8.877 in.	12.510 in.	9.428 in.
5.....	8.602 in.	11.985 in.	9.088 in.
Average.....	**8.629** in.	**12.117** in.	**9.159** in.

For the 100-yard test the rifle was placed in the rest Oct. 10 with the wind blowing 4 miles per hour from the 3 o'clock quarter. The barometer pressure was 32.220 inches, the dry thermometer showed 65° and the wet-bulb thermometer 58°, with a dew point of 52 and the humidity 63 per cent. of saturation. Noting that ammunition and arm were as before, the record stood:

Round.	25 Yards.	50 Yards.	75 Yards.
2.....	2.010 in.	2.491 in.	2.182 in.
3.....	2.224 in.	2.713 in.	2.295 in.
4.....	2.059 in.	2.543 in.	2.165 in.
5.....	2.060 in.	2.516 in.	2.096 in.
6.....	2.212 in.	2.841 in.	2.563 in.
Average.....	**2.113** in.	**2.620** in.	**2.260** in.

Winchester .40.

This favorite magazine weapon was put in the rest for a trial at 200 yards on Sept. 30 at 4 o'clock in the afternoon, when the weather condition showed the barometer at 30.008 inches. The dry thermometer record was 74° and the wet-bulb thermometer 65.5°. This gives us a dew point of 65.5 and the humidity 62 per cent. of saturation. The wind, from the 6 o'clock quarter, was blowing 13 miles per hour. The rifle used, we are sorry to say, was stolen from its place in the rack after the tests had been made, and before the data touching the rifle had been taken. A similar rifle from stock was found to weigh 10 pounds, with 3 pounds 14 ounces in the barrel. Length of octagonal barrel 28 inches.

The rifling had a uniform twist of 1 turn in 40 inches. The six grooves were each .003 inch in depth and .125 inches in width. The loading was from a lot of Winchester-made

ammunition, and three cartridges opened showed that two of the powder charges were in fine condition, while in the third the powder was pressed very hard. The bullet had two grooves and a composition of 16 lead to 1 of tin. The powder charges weighed 57 8, 58.8 and 60 grains, while each of the bullets weighed exactly 210 grains. The trajectory heights at 200 yards were:

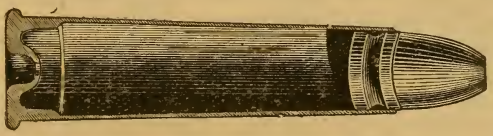
Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.175 in.	11.600 in.	9.217 in.
2.....	7.927 in.	11.447 in.	9.024 in.
3.....	7.904 in.	11.321 in.	8.688 in.
4.....	8.149 in.	11.640 in.	9.065 in.
5.....	8.164 in.	11.550 in.	9.136 in.
Average....	**8.063** in.	**11.511** in.	**9.026** in.

The 100-yard trial of the weapon came on Oct. 5, shortly after the noon hour. The wind was then 18 miles per hour from the 2 o'clock quarter, while the barometer stood 30.170 inches, the dry thermometer at 59°, the wet-bulb thermometer at 52°, giving a dew point of 45 and a humidity of 60 per cent. The charging was as before, and the trajectory figures stand:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.909 in.	2.181 in.	1.993 in.
2.....	1.823 in.	2.185 in.	1.883 in.
3.....	1.881 in.	2.286 in.	1.943 in.
4.....	1.932 in.	2.389 in.	2.033 in.
5.....	1.973 in.	2.413 in.	2.016 in.
Average....	**1.903** in.	**2.290** in.	**1.973** in.

Bullard .40.

This rifle was one of the very complete line of rifles sent down by the Bullard Company, and came on the rest for 200 yards testing at half past three on the afternoon of Sept. 28, the wind at the time coming from the 6 o'clock quarter at the rate of 4 miles per hour. The barometric pressure was 30.200 inches, the dry thermometer 73 2°, the wet-bulb thermometer at 61.6° with a dew point of 52.2, and indicating 48 per cent. humidity in the atmosphere. The rifle had a 26-inch half octagon barrel, and was marked No. 141. Its total weight was 10 pounds 1 ounce, with a barrel weight of 3 pounds 11 ounces. The rifling was uniform, 1 twist in 20 inches, having 5 grooves, each .005 inch deep and .170 inch wide. The loading was with U. M. C. ammunition .40-70 230. The powder being of the FG brand and the bullet composition 20 lead to 1 of tin. The three charges examined showed powder weights of 70, 70.4 and 69.8 grains, the powder in each case being pressed hard, but otherwise



in good condition. The bullets had 2 grooves, and the three tested weighed 226.8, 226.9 and 227.1 grains respectively.

The 200-yard trajectory calculations showed:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	7.232 in.	10.296 in.	7.892 in.
2.....	7.340 in.	10.312 in.	8.672 in.
3.....	7.361 in.	10.514 in.	8.318 in.
4.....	7.113 in.	10.240 in.	8.155 in.
5.....	7.658 in.	11.152 in.	8.826 in.
Average.....	**7.341** in.	**10.503** in.	**8.253** in.

The 100-yard testing came on about the same hour on the afternoon of Oct. 5, with the barometer standing at 30.160

inches, the dry thermometer at 60.5°, the wet-bulb thermometer at 52 6°. This would give a dew point of 45.2 and indicate the humidity as 58 per cent. of entire saturation. Under those conditions the trajectory table stands:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.712 in.	2.098 in.	1.792 in.
2.....	1.704 in.	2.139 in.	1.901 in.
3.....	1.754 in.	2.182 in.	1.852 in.
4.....	1.756 in.	2.181 in.	1.887 in.
5.....	1.786 in.	2.188 in.	2.010 in.
Average.....	**1.740** in.	**2.157** in.	**1.888** in.

Whitney-Kennedy .40.

This make of magazine arm was represented by but two rifles. The .50-caliber express has already been noted. The present arm was put upon the fixed rest Oct. 1, about 2 o'clock in the afternoon, with the wind coming at 10 miles per hour, from the 6 o'clock quarter. The barometric pressure was 30.120 inches, the dry thermometer stood at 78° and the wet-bulb thermometer at 65°, indicating a dew point of 55 and a humidity of 46 per cent. in the atmosphere. The arm itself was marked M. 218, with a 28-inch octagonal barrel. The entire arm weighed 10 pounds 6 ounces, the barrel alone 3 pounds 15 ounces. The rifling had a uniform twist of one turn in 22 inches, and the six grooves were each .006 inches deep and .140 wide. The loading was with ammunition coming from the U. M. C. Co., of Bridgeport, Conn , and on opening the powder was found in fine condition. The bullets with two grooves had a composition of

pure lead. The cartridges were nominally .40-60-210. When opened three charges of powder weighed respectively 60.1,

60 7 and 60.5, while the bullets were 211.1, 211.1 and 209.8. The trajectory table shows:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	7.911 in.	11.355 in.	8.866 in.
2.....	8.217 in.	11.892 in.	9.490 in.
3...	8.821 in.	12.727 in.	9.989 in.
4.....	8.228 in.	11.583 in.	8.958 in.
5.....	8.822 in.	12.653 in.	9.647 in.
Averaae.....	**8.399** in.	**12.044** in.	**9.390** in.

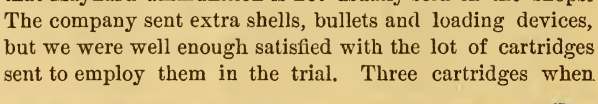
The trial at 100 yards took place at 4 o'clock on the afternoon of Oct. 5. The weather conditions at this time were: Barometer, 30.140 inches; dry thermometer, 58.5°; wet-bulb thermometer, 50°; dew point, 45.1, and humidity, 50 per cent. of saturation. The wind at the time was from the 6 o'clock quarter, six miles an hour. The trajectory figures were as follows:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.054 in.	2.441 in.	2.158 in.
2.....	1.928 in,	2.355 in.	2.086 in.
3.....	1.988 in.	2.442 in.	2.043 in.
4.....	1.920 in.	2.476 in.	2.111 in.
5.....	1.931 in.	2.405 in.	2.140 in.
Average.....	**1.964** in.	**2.423** in.	**2.107** in.

Maynard .40.

There was but one arm of the Maynard pattern in the test, and this was tried at each of the two ranges. Its manner of action by tipping made it an inconvenient one to load after each discharge, but it was very steady in its work, and the muzzle measurements frequently taken enabled the trajectory figures to be accurately determined. The rifle, when the time came to test it, was found to have the firing pin broken off. This in another arm would have made the piece entirely useless, but inquiry showed that the daughter of the range inn-keeper had a little .22-caliber Maynard, with which the fair markswoman was very clever at popping glass balls from a trap. This was borrowed, and it was but the work

of a moment to change the stock from the .22-caliber barrel to the .40-caliber one, and the test went on without any trouble. The accident really enabled us to show one of the points of merit of the Maynard in the interchangeability of barrels on the same stock. The arm had a half octagon barrel, 29 inches long, with the shop mark 2,349. The entire arm weighed 8 pounds 6½ ounces, and in the barrel there were 5 pounds 4 ounces of metal. There were six grooves with a uniform twist of one turn in 28 inches. The grooves were .003 inch deep and .140 inch wide. The loading of the piece was from a lot of cartridges sent down from the armory of the Massachusett Arms Co. with the arm. They were loaded according to the letter of advice accompanying them, with Hazard's FG powder, 70 grains, with a leaden bullet of 240 grains. This is the only case of a breechloader where the loading was done by the parties sending the arm, and the reason is manifest to those who know that Maynard ammunition is not usually sold in the shops. The company sent extra shells, bullets and loading devices, but we were well enough satisfied with the lot of cartridges sent to employ them in the trial. Three cartridges when



opened showed the bullet to have one large groove, while three powder charges weighed up to 57.1, 56 and 60.5 grains, a difference so marked from the nominal weight that the charges were reweighed. The corresponding bullets weighed 243.5, 240.3 and 242.1 grains.

The 200-yard test was made on Oct. 1, with the barometer standing at 30.170 inches, the thermometer at 55°, and the wet-bulb thermometer at 54°, giving a dew point of 53 and a humidity of 93 per cent. It was about 7 o'clock in the morning when the trial was made, and what wind there was came from the 7 o'clock quarter at two miles per hour. The 200-yard trajectory heights stood:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	7.955 in.	11.067 in.	8.871 in.
2.....	7.992 in.	11.054 in.	8.805 in.
3.....	7.922 in.	10.999 in.	8.849 in.
4.....	8.071 in.	11.295 in.	9.033 in.
6.....	7.949 in.	11.021 in.	8.659 in.
Average.....	**7.957** in.	**11.087** in.	**8.843** in.

The 100 yard trial of the arm took place at 8 o'clock on the morning of Oct. 12, with an eighteen-miles-per-hour wind blowing from the 1 o'clock quarter. The barometer reading was 30.315 inches, the dry thermometer stood at 50° and the wet-bulb thermometer at 46.5°, making a calculated dew point of 42 and a humidity of 74 per cent. The arm and ammunition were as before, and the test showed:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.704 in.	2.099 in.	1.801 in.
2.....	1.579 in.	1.986 in.	1.812 in.
3.....	1.766 in.	2.221 in.	1.902 in.
4.....	1.972 in.	2.355 in.	2.035 in.
5.....	1.720 in.	2.114 in.	1.923 in.
Average.....	**1.758** in.	**2.155** in.	**1.895** in.

Marlin .38.

The Marlin .38 55-255 was tried at both distances of the test, and with very uniform results. The weapon weighed complete 9 pounds 1½ ounces, and had a 28-inch octagonal barrel, weighing 4 pounds 8 ounces. The shop mark was 10,909. The rifling was uniform, with a twist of one turn in 20 inches. The six grooves have each a depth of .003 and a width of .138 inch. The loading was with ammunition

coming from the U. M. C. factory, and when opened the powder was found to be pressed quite hard, but in fair condition otherwise. The bullets had four grooves. The three

powder charges weighed each 52 grains exactly, and the three bullets ran 254 8, 254.5 and 254 5 grains.

The 200-yard test was made on Sept. 30, and when the rifle was placed in the rest at 2:20 o'clock in the afternoon the wind was going down the range from the 6 o'clock quarter at 12 miles per hour. The barometer stood 30.02 inches, the dry thermometer 79.4° and the wet-bulb thermometer 68°, indicating a dew point of 60.6 and a humidity in the atmosphere of 53 per cent. Under these conditions the 200-yard record stood

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.414 in.	11.814 in.	9.118 in.
2.....	8.473 in.	11.939 in.	9.191 in.
3.....	8.300 in.	11.683 in.	9.013 in.
4.....	7.978 in.	11.216 in.	8.719 in.
5.....	8.117 in.	11.435 in.	8.769 in.
Average....	**8.256** in.	**11.617** in.	**8.962** in.

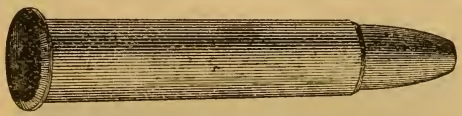
At 100 yards the trial was made on Oct. 10 at 3 o'clock in the afternoon with a 9 o'clock wind blowing 6 miles per hour. The barometric pressure was 30.240 inches, the dry thermometer 66.5° and the wet-bulb thermometer 55.5°. This would show a dew point of 44.5 and a degree of humidity in the atmosphere of 45 per cent. The 100-yard heights in the trajectory line stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.159 in.	2.646 in.	2.208 in.
2.....	2.190 in.	2.639 in.	2.208 in.
3.....	2.147 in.	2.695 in.	2.240 in.
4.....	2.098 in.	2.549 in.	2.179 in.
5.....	2.076 in.	2.522 in.	2.174 in.
Average....	**2.134** in.	**2.610** in.	**2.202** in.

Remington-Hepburn .38.

The Remington section of our armory for trial contributed this arm, which was put on the rest for the 200-yard trial Sept. 30, at 11 o'clock in the forenoon. The wind at eight miles per hour was coming from the 1 o'clock quarter, while the barometer stood at 30.070 inches, the dry thermometer at

80°, the wet-bulb thermometer 69.8°, indicating a dew point of 63 6 and a humidity in the atmosphere of 57 per cent. The arm had a 30-inch half octagon barrel and was numbered 6,082. It had a total weight of 9 pounds 7½ ounces, and a barrel weight reported at 6 pounds 8 ounces. The rifling had a uniform twist of one turn in eighteen inches, and the five grooves had a depth each of .0035 inch and .150 inch wide. The loading was with Remington made ammunition, .38 50-320 in a 2¼-inch shell. Three charges opened showed



charges of hard pressed powder in fair condition, and weighing 52.45, 51.4 and 50.6 grains, while the four-grooved bullets corresponding weighed 322.8, 322.8 and 322.7 grains. The 200-yard record stood:

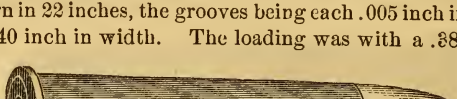
Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.601 in.	12.081 in.	9.142 in.
2.....	8.947 in.	12.554 in.	9.479 in.
3.....	9.055 in.	12.676 in.	9.577 in.
4.....	8.984 in.	12.596 in.	9.543 in.
5.....	8.677 in.	12.135 in.	9.115 in.
Average.....	**8.852** in.	**12.408** in.	**9.371** in.

The 100-yard trial came on Oct. 12, at 4 o'clock in the afternoon, with the wind coming from the 3 o'clock quarter at twelve miles per hour. The barometer marked 30.285 inches, the dry thermometer 55°, and the wet-bulb thermometer 51.2°, showing a dew point of 47.4 and the humidity in the atmosphere as 75 per cent. The record of trajectory heights stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.231 in.	2.837 in.	2.280 in.
2.....	2.239 in.	2.771 in.	2.339 in.
3.....	2.292 in.	2.819 in.	2.254 in.
4.....	2.257 in.	2.739 in.	2.275 in.
5.....	2.111 in.	2.704 in.	2.195 in.
Average.....	**2.226** in.	**2.774** in.	**2.289** in.

Bullard .38.

This weapon came with the line of rifles from the Bullard works, and gave much trouble in the testing, owing to the obstinacy of the carrier block. It had a half octagon 26-inch barrel and was marked No. 1675. The entire rifle weighed 8 pounds and the barrel was marked as having 3 pounds of metal in it. There were five grooves with a uniform twist of one turn in 22 inches, the grooves being each .005 inch in depth and .140 inch in width. The loading was with a .38-45 190



cartridge of U. M. C make. When opened three charges from the lot in use showed the powder in fine condition and weighed 45.7, 44 6 and 45.4 grains in the three charges. The bullets with double groove weighed respectively 188.6, 188.4 and 188 5 grains. The 200-yard firing of the weapon took place on Sept. 29, with the wind blowing from the 6 o'clock quarter at 7 miles per hour. The other weather conditions stood: Barometer, 30.201; dry thermometer, 77 2°; wet bulb thermometer, 69.8°, giving the dew point 65.4 and the humidity 77.2 per cent. Under trial the weapon made the following record:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	8.977 in.	12.673 in.	9.840 in.
3.....	9.105 in.	12.814 in.	9.870 in.
4.....	8.972 in.	12.710 in.	9.834 in.
5.....	8.961 in.	12.790 in.	9.938 in.
8.....	8.756 in.	12.470 in.	9.723 in.
Average	**8.954** in.	**12.691** in.	**9.851** in.

At 100 yards the rifle refused to act, and the carrier bloc brought the entire action to a stop. It was an instance of one of those occasions when even the best arm takes on an ugly fit and seems to have an intelligent obstinacy. With-

out tools to take the rifle apart and ease the action, there was nothing to do but set it aside and deprive our record of the 100-yard test.

Stevens .38.

This is the first of the Stevens make of rifle to come unde notice. The arm has a 26-inch, half-octagon barrel, and wa numbered 12,950. It weighed 7 pounds 2 ounces, with barrel weight of 4 pounds 5 ounces. The twist of the riflin was uniform, having one twist in 18 inches, with six grooves. The loading was with U. M. C. ammunition marked .38-40 145. When opened the bullet was found with one groove,

and three of them weighed 145.7, 145.6 and 145.3 The powder, in fine condition, weighed in the three cartridges 38.7, 38.1 and 39 grains. The rifle gave the same trouble as all the other tip-up barrels when put in the rest, and consumed much time in making the tests. It was put on the rest for 200-yard testing Oct. 19, with the barometer standing 30.250 inches, the thermometric recording being with the dry-bulb 59° and with the wet-bulb 38 5°, denoting a dew point of 58 and a humidity in the atmosphere of 96 per cent. It was half-past 7 in the morning when the test was made and the wind blew from the 6 o'clock quarter at two miles per hour. The longer ranges record stood:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	9.262 in.	13.162 in.	10.302 in.
2.....	9.311 in.	13.318 in.	10.056 in.
3.....	10.088 in.	14.757 in.	11.718 in.
4.....	8.963 in.	12.596 in.	10.078 in.
5.....	9.469 in.	14.105 in.	11.308 in.
Average.....	**9.419** in.	**13.588** in.	**10.692** in.

For the trial at 100 yards the weapon was placed in the rest on Oct. 12, with the wind coming at fourteen miles per hour from the 2 o'clock quarter. The barometer reading was 30.285 inches, the dry thermometer at 57° and the wet-bulb ditto at 53°, making the dew point 49 and the humidity of the atmosphere at 74 per cent. Under these conditions and with ammunition as before noted, the record stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.190 in.	2.701 in.	2.291 in.
2.....	1.999 in.	2.616 in.	2.303 in.
3.....	2.051 in.	2.673 in.	2.262 in.
4.....	2.000 in.	2.558 in.	2.227 in.
5.....	2.087 in.	2.547 in.	2.220 in.
Average.....	**2.065** in.	**2.619** in.	**2.261** in.

Marlin .32.

This is the last of the series of Marlin arms sent from the New Haven armory. It behaved very well in the test and was readily tested. The weapon had a 28 inch octagonal barrel and complete weighed eight pounds, while the barrel alone weighed three pounds one ounce. The rifling was of uniform twist, one turn in sixteen inches, and each of the six grooves was .003 inch deep and .102 inch wide. The loading was with U. M. C. .32-40-165 ammunition. When

examined the powder was found to be pressed very hard, so much so as to crush the powder grains nearest the bullet, beyond this the powder was good. The bullet had four grooves, and had a composition of 1 tin to 20 lead. Three powder charges weighed 43.2, 43.8 and 42.7 grains, while the corresponding bullet weights were 164.2, 164.0 and 164 2 grains.

When tried at 200 yards on Sept. 30, at 5:20 in the afternoon, the wind was from the 6 o'clock quarter at five miles

per hour. The barometer registered 30.006 inches, and the dry and wet thermometer readings were 68.5° and 64° respectively. This shows a dew point of 60.8, and the humidity in the atmosphere as 77 per cent. The long range trajectory table stands:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	6.833 in.	9.660 in.	7.495 in.
2.....	6.983 in.	9.895 in.	7.675 in.
3.....	7.236 in.	10.288 in.	7.922 in.
4.....	7.374 in.	10.450 in.	8.111 in.
5.....	7.255 in.	10.386 in.	8.050 in.
Average...	**7.163** in.	**10.135** in.	**7.850** in.

At 100 yards out of the same lot of ammunition the trial came on at 5 o'clock in the afternoon of Oct. 5, with the thermometer standing at 30.160 inches, the dry thermometer at 57° and the wet-bulb thermometer at 50.5°. The dew point in this case was 44 and the humidity at 62 per cent. Wind was coming from the 7 o'clock quarter at ten miles per hour. The table for this range stands:

Round.	25 Yards.	50 Yards.	75 Yards.
2.....	1.740 in.	2.092 in.	1.762 in.
3.....	1.794 in.	2.145 in.	1.821 in.
4.....	1.735 in.	2.043 in.	1.851 in.
5.....	1.867 in.	2.311 in.	2.036 in.
6.....	1.728 in.	2.050 in.	1.870 in.
Average...	**1.773** in.	**2.128** in.	**1.868** in.

Stevens' Hunters' Pet.

This rifle we were particularly anxious to have in the test, because it is pushed as being an accurate weapon at 40 rods, and also in deference to the requests of many correspondents who were anxious to know what the little pop was capable of in comparison with the heavier arms. The weapon used was of the center-fire model, with an 18-inch octagonal barrel and the usual skeleton stock. It was marked 2,715. The weight of the arm complete was 5 pounds 2½ ounces, while without the stock its weight was 4 pounds 6½ ounces. The barrel-weight is given as 2 pounds 12 ounces. The rifling

was uniform, with six grooves making one turn in 18 inches. The loading was with Winchester-made ammunition, .32-9-85. The powder in the opened cartridges was found in fine

condition, and the bullet with one groove had a composition of 20 lead to 1 of tin. The cartridges were labeled ".32 S. & W., C. F.," being those intended for the Smith & Wesson revolvers, but adapted to the chamber of the Hunters' Pet rifle. Three charges weighed 8 4, 8.7 and 8.4 grains, while the corresponding bullets were 84.6, 85.1 and 84.5 grains.

The trial at 200 yards was made on Oct. 19, at 3 o'clock in the afternoon, and was a sore test of the patience of the experimenter. The shortness of the barrel made it necessary to have considerable building out on the rest to bring the muzzle over the measuring stake, and then the shots flying wild compelled the firing of nearly a score of test shots before five were put through all the screens and on the target. At the time of the test the wind was from the 5 o'clock quarter at 22 miles per hour, with the barometer 30.205 inches, the thermometer 63.2°, the wet-bulb thermometer 58°, giving a dew point of 53.8 and a percentage of humidity of 72. Under these conditions the test stood as follows, and here, as in every other case, the numbers under the head of "round" indicates the order in which the effective, counting shots were made. Other shots went through one or two of the screens, but were not complete enough to measure up.

Round.	50 Yards.	100 Yards.	150 Yards.
2.....	15.832 in.	21.969 in.	16.730 in.
8.....	15.258 in.	21.760 in.	17.091 in.
13.....	15.416 in.	21.570 in.	16.505 in.
14.....	16.066 in.	23.136 in.	17.965 in.
17.....	15.105 in.	21.503 in.	16.686 in.
Average...	**15.535** in.	**21.987** in.	**16.995** in.

At 100 yards, the trial was more readily made, and the shots followed along with fewer gaps. The test took place Oct. 12, at 3:20 in the afternoon, the wind blowing 13 miles per hour from the 3 o'clock quarter. The barometric pressure was 30.285 inches, the thermometer 57° and the wet-bulb do. at 52°, indicating a dew point of 49 and the humidity in the air at 69 per cent. The trajectory heights stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	3.819 in.	4.911 in.	3.942 in.
2.....	3.904 in.	5.120 in.	4.205 in.
4.....	3.532 in.	4.604 in.	3.968 in.
5.....	3.833 in.	5.026 in.	3.905 in.
6.....	4.095 in.	5.114 in.	3.862 in.
Average. ...	**3.837** in.	**4.955** in.	**3.976** in.

Colt .32.

The only Colt in the trial, and a snug little arm—one of the newer make of weapons from the Hartford company. It is the new Lightning Colt, with the trombone motion in working the breech action. The weapon weighed 7 pounds 4½ ounces, having a round 26-inch barrel, and was numbered 7048. The barrel weight was 3 pounds 6 ounces, and the rifling had a uniform twist of one turn in 24 inches, and each of the six grooves was .004 inches deep and .070 wide.

The loading was with U. M. C. Co. ammunition. The cartridges are made specially for this arm, having a 20-grain charge behind a 100-grain pure lead bullet. In the opened cartridges the powder was found in fine condition, and three charges weighed 19.8, 19.6 and 19.5 grains, while the one-grooved bullets corresponding were 99.7, 100.1 and 101.2 grains in weight. The 200-yard trial took place Sept. 29 at 1 o'clock P. M. The barometer stood at 30.180 inches, the dry thermometer at 76.7°, the wet-bulb thermometer at

70°, showing a dew point of 65.9 and the humidity in the atmosphere at 69 per cent. of saturation. The wind came from the 7 o'clock quarter at seven miles per hour. The trajectory heights ran:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	9.546 in.	13.554 in.	10.722 in.
2.....	10.080 in.	14.380 in.	11.107 in.
3.....	9.515 in.	13.700 in.	10.635 in.
5.....	9.780 in.	13.996 in.	10.859 in.
6.....	9.496 in.	13.622 in.	10.542 in.
Average.....	**9.683** in.	**13.550** in.	**10.773** in.

At 100 yards the trial came on at half-past 2 on the afternoon of Oct. 10, with the wind from the 9 o'clock quarter at ten miles per hour. The barometer stood at 30.220 inches, the dry thermometer 67°, the wet-bulb thermometer 55.2°, showing the dew point at 43.4 and the humidity at 43 per cent. Under these conditions the 100-yard trajectory table stands:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.450 in.	2.948 in.	2.542 in.
2.....	2.239 in.	2.809 in.	2.370 in.
3.....	2.356 in.	2.967 in.	2.552 in.
4.....	2.218 in.	2.802 in.	2.340 in.
5.....	2.320 in.	2.917 in.	2.483 in.
Average.....	**2.316** in.	**2.899** in.	**2.453** in.

Remington-Hepburn .32.

This arm is one of the new output from the Ilion armory and was an admirable close shooter. Its side snap action, of the Hepburn patent, made it as convenient as a Springfield in the rest. The barrel was a 28-inch, half octagon and marked 6097. Its full weight was 7 pounds 11½ ounces and of the barrel 4 pounds 8 ounces. The rifling was of uniform twist, having one turn in 16 inches. There were five grooves, each .003 inch deep and .110 inch wide. The loading was with Remington made ammunition, using Hazard

FFG powder, 40 grains, and a three-groove bullet made up of one part tin to ten of lead. The shell waa 2⅛ inches long. There are four various sorts of ammunition made for this arm, each with 40 grains of powder, but with 125 and 150 grains grooved and 150 and 175 patched bullet respectively. The test was made with the first named. Although had not

the chronic excuse "out of that ammunition" been given when our messenger went to purchase other cartridges, we would gladly have made the test with the heavier bullet as well. The powder was found in fine condition and when weighed up three charges showed 40.2, 40.7 and 40.8 respectively, while the bullets were 118.5, 119.2 and 120.5. The 200-yard trial came at 10:40 on the morning of Sept. 30 with the wind coming from the 10 o'clock quarter at 7 miles per hour. The barometer stood 30.08 inches, the dry thermometer 79° and the wet-bulb thermometer at 69°, while the dew point of 63 indicated a humidity of 58 per cent. With these weather environments the figures at this range stand:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	6.119 in.	8.717 in.	6.856 in.
2.....	6.123 in.	8.680 in.	6.757 in.
3.....	6.600 in.	9.233 in.	7.312 in.
4.....	6.445 in.	9.056 in.	7.078 in.
5.....	6.205 in.	8.766 in.	6.820 in.
Average.....	**6.298** in.	**8.890** in.	**6.964** in.

For the 100-yard test the rifle was put on the stand Oct. 10, at 10 o'clock in the morning with the wind from the 10 o'clock quarter at 10 miles per hour, and the rifle scored a "ten strike." The barometer rose to 30.285 inches, the dry thermometer to 61°, while the wet-bulb thermometer registered 57°, making a dew point of 54 and a humidity of 78

per cent. of thorough saturation of the atmosphere. The trajectory stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.513 in.	1.815 in.	1.544 in.
2.....	1.477 in.	1.870 in.	1.560 in.
3.....	1.443 in.	1.770 in.	1.554 in.
4.....	1.429 in.	1.757 in.	1.477 in.
5.....	1.478 in.	1.804 in.	1.488 in.
Average.....	**1.468** in.	**1.803** in.	**1.525** in.

Remington .32, R. F.

Another rifle of the pop-gun order, yet of a class of rifles which finds much sale and evidently enjoys a great popularity among that numerous class who seek small game and wish an arm proportionate. The weapon was of the old Remington model, and used a rim-fire cartridge. It had a 26-inch octagonal barrel, and was marked 767. Its complete weight was 7 pounds, of which 4 pounds 8 ounces were in the barrel. The rifling was of uniform twist, one turn in 20 inches, and the five grooves had each a depth of .003 inch and a width of .110 inch. The loading was with U.

M. C. ammunition, the .32 long rim-fire cartridges, .32-13-90, being used. When opened the powder was found in fine condition, and the three-grooved bullet had a pure lead composition. When weighed three powder charges showed 11.9, 12.4 and 12.2 grains, while the corresponding bullets weighed 88.6, 88.9 and 88.7 grains.

The weather conditions at the time of the test on Oct. 1, at half past 2 in the afternoon showed the wind blowing from the 6 o'clock quarter at 7 miles per hour, while the other readings were: Barometer 30.08 inches; dry thermometer 75.5°; wet-bulb thermometer 63°, indicating a dew point of 53.3, and a humidity of 47 per cent. The heights as calculated stood:

Round.	50 Yards.	100 Yards.	150 Yards.
1.....	12.562 in.	17.860 in.	13.843 in.
2.....	12 361 in.	17.597 in.	13.323 in.
3.....	13.400 in.	18.516 in.	14.291 in.
4.....	12 585 in.	17.844 in.	13.731 in.
5.....	13.777 in.	19.171 in.	14.682 in.
Average.....	**12.937** in.	**18.237** in.	**13.974** in.

The 100-yard trial came off Oct. 10, at 5 o'clock in the afternoon, with the wind coming from the 9 o'clock quarter at 4 miles per hour. The barometric pressure was 30.240 inches, the dry thermometer 59°, and the wet-bulb instrument at 54°, showing the dew point 49 and the humidity at 70 per cent. The heights as deduced from the screens stood:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	3.168 in.	3.998 in.	3.257 in.
2.....	3.063 in.	3.669 in.	3.080 in.
3.....	3.247 in.	4.036 in.	3.257 in.
4.....	3.251 in.	4.284 in.	3.442 in.
5.....	3.041 in.	3.852 in.	3.187 in.
Average.....	**3.154** in.	**3.968** in.	**3.245** in.

Stevens .32 R. F.

This weapon is a sample of the old-time Stevens rifle, using a rim-fire cartridge with small charge of powder. It was, in fact, the same cartridge used in the Remington .32 R. F. weapon, and the same weighing up of charges and bullets hold as in that arm, the powder running 11.9, 12.4

and 12.2 grains, while the bullets were 88.6, 88.9 and 88.7 grains. The powder was in fine condition, and the bullets had three grooves. The ammunition was of U. M. C. Co. make. The weapon weighed, complete, 8 pounds 9½ ounces, while the barrel alone weighed 4 pounds 2 ounces. The weapon was numbered 14,302, and had a 30-inch octagonal

barrel. There were six grooves of uniform twist, having one turn in 20 inches.

The trial at 200 yards was made on Oct. 1 at 11 o'clock in the morning, with the wind coming from the 7 o'clock quarter at ten miles per hour. The barometer recorded 30.120 inches, the dry thermometer 78° and the wet-bulb thermometer 65.4°, showing a dew point of 56.3 and the atmospheric humidity at 47 per cent. The trajectory heights stood:

Round.	50 Yards.	100 Yards.	150 Yards.
2.....	12.718 in.	18.019 in.	13.876 in.
3.....	12.852 in.	18.079 in.	14.193 in.
4.....	12.439 in.	17.698 in.	13.583 in.
5.....	13.312 in.	18.562 in.	14.341 in.
7.....	12.622 in.	17.735 in.	13.645 in.
Average...	**12.788** in.	**18.018** in.	**13.927** in.

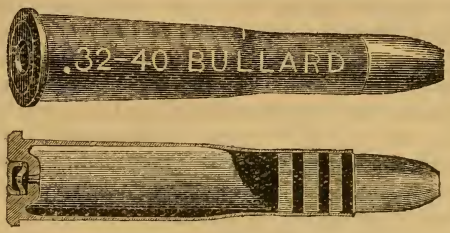
At 100 yards the test came on Oct. 10, about 9:15 in the morning, with the barometer standing at 30.320, the dry thermometer 58° and the wet-bulb thermometer at 52°, indicating a dew point of 46 and a humidity of 65 per cent. The wind at the time was blowing at 7 miles per hour from the 10 o'clock quarter. The short range trajectory figures stand:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	2.773 in.	3.735 in.	2.993 in.
3.....	3.056 in.	3 814 in.	3.175 in.
4.....	2.945 in.	3.652 in.	3.036 in.
5.....	2.985 in.	3.736 in.	3.137 in.
6.....	2.900 in.	3.794 in.	3.198 in.
Average....	**2.932** in.	**3.746** in.	**3.108** in.

Bullard .32.

This weapon closed the Bullard list and behaved very well in the rest. Its full weight was 8 pounds 8 ounces, and in the barrel alone were 3 pounds 5 ounces of metal. It had a 26-inch octagon barrel, and was numbered 1528. The rifling was uniform, the six grooves having each a uniform twist of

one turn in 16 inches. The grooves were .004 inch deep and .080 inch wide. The loading was with U. M. C. Co. cartridges marked .32 40-150, and three when opened turned



out the powder in good condition. The bullets, having a composition of 1 tin to 16 lead, had three grooves each and weighed 150 1, 150.3 and 150.2 grains, while the corresponding powder weights were 38.8, 39.4 and 38.2 grains. The 200-yard shooting was performed on Sept. 30 at 11:50 A. M., with the wind at nine miles an hour from the 7 o'clock quarter. The barometer stood 30.05 inches, the dry thermometer 78.5°, the wet thermometer 68.5°, showing a dew point of 63.5 and a humidity of 58 per cent. The trajectory heights stood:

Round.	50 Yards.	100 Yards.	150 Yards.
2.....	7.986 in.	11.373 in.	8.748 in.
5.....	7.906 in.	11.428 in.	8.657 in.
7.....	7.742 in.	11.044 in.	8.439 in.
8.....	7.773 in.	11.083 in.	8.509 in.
9.....	8.259 in.	11.786 in.	9.012 in.
Aversge.....	**7.933** in.	**11.342** in.	**8.673** in.

The 100-yard shooting of this arm was done on Oct. 10, with the wind coming eighteen miles per hour from the 1 o'clock quarter. It was 8:50 o'clock and the barometer stood 30.310 inches, the dry thermometer 51.5° and the wet-bulb thermometer 48.5°. This would show a dew point of 45.5 and a humidity of 80 per cent. While the arm was on the rest and shooting very steady it was thought a good time to test one question which had been suggested during the tests. This was the determination of just how much and to

what degree the tests were affected, if at all, by the intervening screens. "Oh, you will find that the screens, even if of gossamer, will have some effect in deflecting the bullet from a true, fair curve," said one well-known rifleman. "All right, then, we will determine that question very quickly," we said, "and find out what the retardation is and how the trajectory curve is affected." We know that a fluttering leaf may very sensibly change the course of a flying bullet, and that with screens set at an angle to the line of fire a certain carrom or ricochet effect might be produced. For this reason great care had been taken in having the screens set square across the fire line.

When five shots had been fired the 25-yard screen, nearest the rifle, was taken down, and without disturbing the others three more shots were fired, making a record on the remaining targets, and then to have the record complete the 50-yard or central screen had its ink line record taken and was then removed, leaving the bullet with an uninterrupted passage to the t arget except through the 75-yard screen. The record is given in full and it will be found that there is no material difference whether the record is made at once through three screens or whether only one is used. To try the various distances through one screen at a time, would have consumed much time and besides would have prevented entirely the detection of that gyratory, corkscrew flight of the bullet so clearly shown in the case of several of the large caliber rifles. The full record stands:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	1.958 in.	2.339 in.	2.001 in.
2.....	1.938 in.	2.278 in.	1.984 in.
3.....	2.062 in.	2.470 in.	2.064 in.
4.....	2.104 in.	2.541 in.	2.175 in.
7.....	2.175 in.	2.591 in.	2.211 in.
Average....	**2.047** in.	**2.443** in.	**2.087** in.
		2.554 in.	2.144 in.
		2.352 in.	2.002 in.
		2.611 in.	2.213 in.
			2.114 in.
			2.030 in.
			2.145 in.

Winchester, Long .22 R. F.

The list of rifles closes with two of .22-caliber. The first of this pair is the Winchester, using the long .22 rim-fire cartridge. The arm is of the 1873 model, with a 24-inch octagonal barrel, and was shop-marked 191,651B. It weighed complete 9 pounds 3 ounces, and had a barrel of 3 pounds 9 ounces weight. There were six grooves, each hav-

ing a uniform twist of one turn in 20 inches, and a depth of .003 inch and width of .070 inch. The loading was from a box of U. M. C. Co. ammunition. The cartridge was nominally .22-5 40. When opened, the powder in three cartridges was found in fine condition and weighed 4 4, 4.4 and 4.6 grains. The bullets had three small grooves each, and were molded of pure lead. They weighed 40.2, 40.3 and 40.1 grains. At 200 yards the rifle was tested on Oct. 19, at 9:50 A. M., with the wind at four miles per hour from the 8 o'clock quarter. The barometer reading was 30.225 inches, with the dry thermometer at 62° and the wet-bulb thermometer at 58.5°, showing a dew point of 56 and the degree of humidity in the atmosphere at 81 per cent. The arm under these conditions gave the following result:

Round.	50 Yards.	100 Yards.	150 Yards.
1	13.506 in.	18.808 in.	14.455 in.
2	13.023 in.	18.247 in.	14.085 in.
3	13.610 in.	19.066 in.	14.632 in.
4	13.720 in.	19.229 in.	14.952 in.
5	13.594 in.	19.273 in.	14.850 in.
Average...	**13.490** in.	**18.922** in.	**14.614** in.

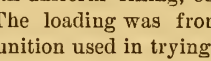
For the 100-yard trial the little piece was put on the fixed rest Oct. 10, with the barometer at 30.240 inches, the dry thermometer at 62° and the wet-bulb thermometer at 54°, showing that the dew point was 46 and the humidity 56 per cent. of saturation. It was 4:45 P. M. when the test shots

were fired, the wind coming from the 9 o'clock quarter at four miles per hour. The trajectory heights show:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	3.282 in.	4.219 in.	3.467 in.
2.....	3.238 in.	4.168 in.	3.382 in.
3.....	3.158 in.	4.133 in.	3.439 in.
4.....	3.294 in.	4.259 in.	3.503 in.
5.....	3.306 in.	4 268 in.	3.597 in.
Average....	**3.256** in.	**4.209** in.	**3.478** in.

Stevens .22, R.F.

The rifle, the last one of our list of sporting and hunting arms, weighed entire 8 pounds 7 ounces and in the barrel alone there were 5 pounds of metal. The barrel was 26 inches long and round. Its shop mark was 15,924. The weapon was cut with uniform rifling, one turn in 20 inches and six grooves. The loading was from the same box of U. M. C. Co. ammunition used in trying the Winchester .22 and the remarks there as to the character and condition of



the charge of course apply here. When tried at 200 yards at 9 o'clock on the morning of Oct. 19 the wind came at 3 miles per hour from the 7 o'clock quarter, while the other observations stand recorded as: Barometer 30.250 inches; dry thermometer 62.5°, wet-bulb thermometer 61°, indicating a dew point of 59.7 and the humidity of the air as 91 per cent. The record stood:

Round.	50 Yards.	100 Yards.	150 Yards.
3.....	14.911 in.	20.992 in.	16.244 in.
5.....	14.612 in.	20.494 in.	15.844 in.
6.....	14.874 in.	20.722 in.	16.144 in.
11.....	16.015 in.	22.412 in.	17.412 in.
12.....	14.780 in.	20.731 in.	16.066 in.
Average....	**15.038** in.	**21.070** in.	**16.342** in.

For 100 yards trial the tip up weapon was fitted to the rest at 7 o'clock on the morning of Oct. 12, at which time the

wind came from the 2 o'clock quarter with a velocity of 18 miles per hour. The index on the aneroid barometer stood at 30.290 inches, the dry thermometer column rose to 48.5°, while the wet-bulb thermometer stood at 44.8°. This would show a dew point of 39.8 and the humidity in the atmosphere as 71 per cent. The trajectory table stands:

Round.	25 Yards.	50 Yards.	75 Yards.
1.....	3.539 in.	4.602 in.	3.790 in.
2.....	3.414 in.	4.305 in.	3.431 in.
3.....	3.423 in.	4.404 in.	3.578 in.
4.....	3.509 in.	4.427 in.	3.449 in.
5.....	3.783 in.	4.736 in.	3.908 in.
Average.....	**3.534** in.	**4.495** in.	**3.651** in.

WE have now set forth all the facts touching the several rifles placed in competitive test in the trajectory trial undertaken by and carried through under the auspices of the FOREST AND STREAM. There are a few other weapons which we would gladly have seen making a record side by side with those already in, but circumstances prevented us from securing them, and besides it was the intention, departed from in but few instances, to confine the trial to bona-fide hunting weapons. What those rifles will do, what may fairly be expected of them under similar or like conditions prevailing in the trial is now within the knowledge of all our readers. We feel certain that there will be a period put to much of the imaginative writing which has been so largely the fashion on this subject. Here in our tables may be found a body of facts deduced from actual experiment. They are worthy of much study. To look at the trajectory averages and them only would be very misleading. They should be looked at in connection with the table of powder charges and proportion between powder and ball. We expect a flat line of fire from a charge where the proportion is 1 to 1 or 1 to 2; but is it after all worth the punishment of person and the waste of material to get the very slight advantage in accuracy and flat fire line? To make practice

and theory come together may be intensely interesting to the rifle virtuoso, applying the term to him who finds a certain keen pleasure in using the experimental range to verify his theories, but when it comes to the practical question of buying a rifle for use, there are other matters to be considered, and it is to afford some light to this large class that our trial was started and carried through. We have found that our results correspond with those reached by theory, but it was manifestly impossible to subject each of the rifles offered to the tests necessary to get the elements of the formula used in deducing the trajectory heights. The simplest method and most satisfactory, we feel sure, to the majority of our readers was that which we pursued, taking the weapon, loading and firing, catching the record of the fleeting bullet upon the gossamer tell-tale screens interposed. It is interesting in this connection to make up a series of supplementary tables from those in the 200-yard test. Here between the 50 and 150 yards screen we have a 100-yard range with a midway screen. A new 50-yard height of the bullet in progress can thus readily be calculated, or looking at it in another way, in the 200-yard shooting by assuming the 100-yard screen to be the target, we have an intermediate screen, and the conditions are precisely similar to the 100 yard firing through the 50-yard screen.

Take for instance the Winchester .50 solid ball. In shot No. 1 at 200 yards, call screen at 100 yards the target: 11.305÷2 =5.652=base line on 50-yard screen. 7.727—5.652=2.075, which is the curve for that shot. The other four shots show the following curves on 50-yard screen by same method of calculation: 2.296, 2.583, 2.243 and 2.480. This gives average for the five shots 2.335 and this may be used as a basis of comparison, in place of the figures actually obtained in the 100-yard test. The same computation with the Winchester .50 express bullet, taking the 100-yard curve from the 200-yard test, shows an average for the 50-yard screen of 2.351, which almost exactly coincides with the result of the 100 yard test, and is a further proof of the steady shooting of the rifle in both tests with express bullet, so far

as the 50-yard screen is concerned. Taking the Whitney-Kennedy .50-caliber solid ball and computing the 100-yard curve from the 200-yard test, we get an average of 2.004 for the 50-yard screen, and so on with any rifle.

Incidental to the test of rifles it will be seen that we have made it a test of cartridges as well. In turning out the powder from the shell after the bullet had been carefully drawn, a note was made of the condition of the charge, if the powder grains were bright and unbroken and seemingly in first-class condition, it is entered as fine, while below this other grades of good and fair are entered. In this the same classification has been followed as that employed by the U. S. officer in making inspections of cartridges sent out for the use of the arms or for experimental purposes. How close the tested cartridges come up to the labels our report in each instance shows. We think that upon the whole the factory makers of cartridges have reason to be congratulated upon the great accuracy with which, assisted by fine machinery and great care in all stages, they have been enabled to turn out in such large quantity, fixed ammunition at such cheap rates. We have noted at various points the powder used by the various companies. The U. M. C. Co. employed the FG brand from either the Laflin & Rand or Dupont works; the Remingtons draw their supplies from the Hazard mills, while the "Rifle Cartridge Powder" of the American Powder Mills product is used by the Winchester Co. One part tin to twenty of lead is the general proportion, the bullet in a few cases being of pure lead. This last condition was true in the case of the three rim-fire cartridges from the Bridgeport factory and in the Bullard solid .50-115-346 and in the Winchester .40-60-210 from the same works.

The weather observations taken during the tests were intended to cover everything which in any way might tend to have an influence upon the rifle during the trial. Generally the conditions were very favorable to the weapon. The wind ran through the Signal Service scale from light wind through gentle and fresh up to brisk. In direction, of course, being at Creedmoor, every point of the compass or dial is

represented in the table of wind quarters. The barometric readings are, of course, familiar to all, and the object in having observations taken with both wet and dry-bulb thermometers was to determine the dew point and then the humidity of the atmosphere. The dew point is that at which the density of the vapor in the air becomes equal to the maximum density corresponding to the temperature. This temperature is called the dew point of the given mass, and any further reduction of temperature will be accompanied by the condensation of a portion of the vapor which will take the form of dew, rain, snow, or hoar frost, according to circumstances. The humidity is that condition of the air, as regards moisture, which gives the ratio of the amount of vapor present in the air to the amount which would saturate the air at the actual temperature. It is upon this that our sensations of dryness or moisture chiefly depend. It is sometimes called relative humidity, and it is usually expressed in a percentage. For instance if the weight of vapor present is seven-tenths of that required for saturation, the humidity is said to be 70 per cent. It will be seen that this has an important bearing upon the condition of the interior of the rifle barrel, especially when, as in these tests, the firing was done with a dirty barrel likely to be clogged by caking powder scum. All the calculations in connection with the meteorological conditions surrounding the test were made by an officer connected with the U. S. Signal Service, and may be relied upon.

We wish in closing to again call attention to the fact that we were in no wise making a trial of the accuracy of the rifles kindly placed in our care. Had we been inclined to make any such, which we were not, an entirely different plan of operations would have been adopted. Hence it is that there are no targets published. It would have been not only unfair and misleading to make such exhibits, but they would have needlessly encumbered the record. Each rifle is undergoing a continuous test for accuracy. Our rifle scores, published from week to week of what is going on upon scores of ranges, are simply returns of accuracy tests,

of course with a test of personal marksmanship attached, and without this latter we know of no satisfactory machine for making such a test. Nothing has yet been devised which can take the place of the human rifle holder. There is a nice poise and counterpoise in a rifle held to the shoulder, firmness and steadiness before the discharge, give and balance after recoil sets in, which it is impossible to simulate by any combination of swinging frames and slides and springs. All this is essential when an accuracy test is carried on, and these each marksman must conduct personally for his own information if he would get any knowledge of value to himself.

The final table which we present brings the list of trajectory heights into convenient form for immediate comparison, and many other facts are there set forth in a shape for ready reference.

In concluding, we tender our thanks again to the several rifle companies who have so kindly sent arms for the trial, and in some cases, we regret to say, got them back rather the worse for wear; to Gall & Lembke, opticians, of Union square, for the several instruments by which the scientific observations of the weather were taken; to the Fairbanks Scale Company, for a pair of balances by which the weights of the rifle, complete, were taken as tested. The officers of the National Rifle Association placed a portion of the Creedmoor range at our disposal, and we were thus enabled to carry on our trial, which is of world-wide importance in many respects, upon a range which has been in the past the scene of many international contests.

INDEX.

Accuracy Test, Not an..... 94
Calculating the Trajectories... 20
Cartridges..... 93
Company Responses..... 6
Dew Point..... 94
Humidity..... 94
Invitation to the Trial..... 6
List of Rifles..... 8
Measurements, How Taken....
Meteorological Observations..
Object of the Trial.....
Rest Description.....
Screens .....
Screens, Effect of.....
Wind, How Named.....

TRAJECTORY FIGURES.

Ballard .40-85..... 65
Ballard .40-70..... 64
Bland .45, Double Barrel..... 53
Bullard .50, Solid Ball..... 37
Bullard .50, Express Ball..... 39
Bullard .45..... 48
Bullard .40..... 69
Bullard .38..... 76
Bullard .32..... 86
Colt .32..... 81
Hunters' Pet (Stevens)..... 79
Marlin .45..... 46
Marlin .40..... 62
Marlin .38..... 73
Marlin .32..... 78
Maynard .40..... 71
Merrill Muzzleloader..... 59
Romer Muzzleloader..... 61
Remington .32, R. F..... 84
Remington .50, N. Y. State Mil. 44
Remington-Hepburn .40.....
Remington-Hepburn .38.....
Remington-Hepburn .32.....
Sharp .45.....
Springfield, U. S. A. Model...
Stevens .38.....
Stevens 32, R. F.....
Stevens Hunters' Pet.....
Stevens .22, R. F.....
Wesson .44, R. F.....
Whitney - Kennedy .50, Soli Ball.....
Whitney-Kennedy .50, Expres Ball .....
Whitney-Kennedy .40.....
Winchester .50, Solid Ball...
Winchester .50, Express Ball
Winchester .45.....
Winchester .40.....
Winchester .22, R. F.....

Antelope and Deer

Tabulated Summary of Trajectory Test.

No.	NAME.	Weight of Rifle.	Weight of Barrel.	Length of Barrel.	RIFLING. Uniform or Gain.	RIFLING. One turn in Twist.	RIFLING. No. of Grooves.	RIFLING. Depth of Groove.	RIFLING. Width of Groove.	CARTRIDGE.	100-Yard Trajectory. 25 Yards.	100-Yard Trajectory. 50 Yards.	100-Yard Trajectory. 75 Yards.	200-Yard Trajectory. 50 Yards.	200-Yard Trajectory. 100 Yards.	200-Yard Trajectory. 150 Yards.
		lb. oz.	lb. oz.	in.		in					inch.	inch.	inch.	inch.	inch.	inch.
1	Marlin .45	9 11	3 11	28	U	20	6	.003	.158	.45–85–285, Naked, C. F., U. M. C.	1.131	2.125	1.612	7.596	11.236	9.019
2	Marlin .40	11 1	5 1	28	U	20	6	.003	.153	.40–60–260, Naked, C. F., U. M. C.	1.991	2.453	2.104	8.120	11.625	8.967
3	Marlin .38	9 1⅓	4 8	28	U	20	6	.003	.138	.38–55–255, Naked, C. F., U. M. C.	2.134	2.610	2.202	8.256	11.617	8.962
4	Marlin .32	8	3 1	28	U	16	6	.003	.102	.32–40–165, Naked, C. F., U. M. C.	1.773	2.128	1.868	7.163	10.135	7.850
5	Ballard .40–70	10 3½	6 0	30	U	20	6	.003	.153	.40–70–330, Patched, C. F., Win.	1.999	2.452	2.116	7.912	11.069	8.344
6	Ballard .40–85	10 15	6 11	32	U	20	6	.003	.153	.40–85–370, Patched, C. F., U. M. C.	1.708	2.061	1.821	7.037	9.893	7.450
7	Rem.-Hep. .40	11 3	7 ½	30	U	20	5	.0035	.160	.40–65–325, Patched, C. F., Rem.	2.113	2.620	2.260	8.629	12.117	9.159
8	Rem.-Hep. .38	9 7½	6 8	30	U	18	5	.0035	.150	.38–50–320, Naked, C. F., Rem.	2.226	2.774	2.289	8.852	12.408	9.371
9	Rem.-Hep. .32	7 11½	4 8	28	U	16	5	.003	.110	.32–40–120, Naked, C. F., Rem.	1.468	1.803	1.525	6.298	8.890	6.964
10	Remington .32	7	4 8	26	U	20	5	.003	.110	.32–13–90, Naked, R. F., U. M. C.	3.154	3.968	3.245	12.937	18.237	13.974
11	Rem. (Mil.) .50	8 12	.....	36	U	42	5	.006	.170	.50–70–450, Naked, C. F., Win.	2.332	2.986	2.469	10.050	13.635	10.530
12A	Winchester .50	10 1	3 2	26	U	60	6	.003	.160	.50–95–312 (Solid), Naked, C.F., Win.	1.740	2.203	2.210	7.966	11.262	8.513
12B	Winchester .50	10 1	3 2	26	U	60	6	.003	.160	.50–95–300 (Ex.), Naked, C.F., Win.	2.096	2.388	2.156	8.002	11.306	8.492
13	Winchester .45	10 8	3 10	30	U	20	6	.003	.142	.45–75–350, Naked, C. F., Win.	1.997	2.532	2.159	8.502	11.979	9.359
14	Winchester .40	10	3 14	28	U	40	6	.003	.125	.40–60–210, Naked, C. F., Win.	1.903	2.290	1.973	8.063	11.511	9.026
15	Winchester .22	9 3	3 9	24	U	20	6	.003	.070	.22–5–40, Naked, R. F., U. M. C.	3.256	4.209	3.478	13.490	18.922	14.614
16A	Bullard .50	10 ⅓	3 8	28	U	72	6	.006	.175	.50–115–350 (Sol.), Naked, C.F., U.M.C	1.598	1.817	1.657	7.261	10.289	7.968
16B	Bullard .50	10 ⅓	3 8	28	U	72	6	.006	.175	.50–115–300 (Ex.), Naked, C.F., U.M.C	1.690	2.047	1.878	7.206	10.493	8.189
17	Bullard .45	9 14	3 6	26	U	30	5	.004	.160	.45–85–290, Naked, C. F., U. M. C.	1.791	2.210	1.891	7.726	11.127	8.727
18	Bullard .40	10 1	3 11	26	U	20	5	.005	.170	.40–70–230, Naked, C. F., U. M. C.	1.740	2.157	1.888	7.341	10.503	8.253
19	Bullard .38	8	3 0	26	U	22	5	.005	.140	.38–45–190, Naked, C. F., U. M. C.	.....	.....	.....	8.954	12.691	9.851
20	Bullard .32	8 8	3 5	26	U	16	6	.004	.080	.32–40–150, Naked, C. F., U. M. C.	2.047	2.443	2.087	7.933	11.342	8.673
21A	Whit.-Ken. .50	8 11	3 8	26	U	30	6	.006	.160	.50–95–312 (Solid), Naked, C.F., Win.	1.477	1.178	1.229	7.517	11.024	8.665
21B	Whit.-Ken. .50	8 11	3 8	26	U	30	6	.006	.160	.50–95–300 (Ex.), Naked, C. F., Win.	1.723	2.530	1.629	7.800	11.569	9.105
22	Whit.-Ken. .40	10 6	3 15	28	U	22	6	.006	.140	.40–60–210, Naked, C. F., U. M. C.	1.964	2.423	2.107	8.399	12.044	9.390
23	Stevens .38	7 2	4 5	26	U	18	6	.....	.....	.38–40–145, Naked, C. F., U. M. C.	2.065	2.619	2.261	9.419	13.588	10.692
24	Stevens .32	8 9½	4 2	32	U	18	6	.....	.....	.32–13–90, Naked, R. F., U. M. C.	2.932	3.746	3.108	12.788	18.018	13.927
25	Hunters' Pet	5 2½	2 12	18	U	18	6	.....	.....	.32–9–85, Naked, C. F., Winchester.	3.837	4.955	3.976	15.535	21.987	16.995
26	Stevens .22	8 7	5 0	26	U	20	6	.....	.....	.22–5–40, Naked, R. F., U. M. C.	3.534	4.495	3.651	15.038	21.070	16.342
27	Maynard .40	8 6½	5 4	29	U	28	6	.003	.140	.40–70–240, Naked, C. F., Maynard.	1.758	2.155	1.895	7.957	11.087	8.843
28	Wesson .44	8 6	.....	30½	.....	.....	.....	.....	.....	.44–28–214, Naked, R. F., U. M. C.	3.499	4.532	3.730	13.979	19.213	14.628
29	Colt .32	7 4½	3 6	26	U	24	6	.004	.070	.32–20–100, Naked, C. F., U. M. C.	2.316	2.899	2.453	9.683	13.550	10.773
30	Spring. (Mil.) .45	8 8	3 9	32	U	22	3	.005	.235	.45–70–500, Naked, C. F., U. S.	2.325	2.894	2.454	9.406	12.987	9.956
31	Sharps .45	10 3	5 4	30	U	20	6	.003	.120	.45–70–405, Naked, C. F., U. M. C.	2.081	2.620	2.230	8.533	11.659	8.893
32A	Bland .45	8 13	5 8	28	U	36	6	.007	.200	.45–110–310 (Sol.), Patched, C.F., Eley	1.052	1.410	1.283	5.036	7.530	5.793
32B	Bland .45	8 13	5 8	28	U	36	6	.007	.200	.45–110–275 (Ex.), Patched, C.F., Eley	1.175	1.334	1.283	.....	.....	.....
33	Merrill (Muzzle) .42	11 6½	8 6	28	G	34	6	.010	.105	.42–100–213	1.130	1.306	1.273	.....	.....	.....
34	Romer (Muzzle) .42	14 12	11 12	27	G	34	6	.010	.105	.42–130–270	.....	.....	.....	4.499	6.399	4.903

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